DOES U.S. FOOD AID HAVE DISINCENTIVE EFFECTS ON LOCAL FOOD PRODUCTION?

BY

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THESIS

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Abstract

Food aid is an important tool to fight poverty and avert humanitarian crises in developing countries. Although multiple studies on U.S. food aid have been carried out in the past few decades, the answer to the question— what is the impact of food aid on agricultural production— remains unclear. Many empirical studies focus on the household level, and their results vary widely depending on the characteristics of the country as well as the time period of interest. Our study, instead, uses country-level data in 118 recipient countries from 1961–2006. This paper examines the patterns of food aid allocation using a random effects tobit model, and provides policy-makers causal evidence of the average effects of food aid on food production. To address reverse causality between food aid and local production, we adopt the instrumental variable method as the identification strategy. Specifically, we use a three-way interaction term of U.S. wheat stocks, the dollar amount of U.S. military assistance measured in logarithm, and a measurement of a country's alliance with the U.S. as the instrument for the endogenous variable food aid. In addition, we reconcile commodities in production and food aid data to make sure that exactly same commodities are included in the aggregate group. We find that U.S. food aid shipments are responsive to donor's political interests as well as recipient countries' needs. U.S. cereal aid may negatively affect cereal production in recipient countries. When the U.S. doubled food aid donations, production would decrease by 1.5% on average, which means that an increase in the amount of U.S. food aid by a mean value of 70,832 metric tons would result in an average reduction in production of 173,952 metric tons. This disincentive effect of food aid on production is particularly significant for Sub-Saharan African countries, low-income countries, and regular recipients of U.S. food aid. However, food aid generates insignificant adverse impact on production when food aid is used for humanitarian needs. The heterogeneous effects of food aid on production are important for policy makers in order to evaluate and redesign the food aid programs.

To Mother and Father

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CHAPTER 1

INTRODUCTION

Food aid is an important tool to fight poverty and avert humanitarian crises in developing countries. The past fifty years have witnessed an increase in the prevalence of poverty in developing countries as a result of frequent outbreaks of conflict, severe natural disasters, high population growth, and slow or stagnant growth in domestic food production. In 2015, 795 million people lived in extreme poverty and were chronically undernourished (FAO, IFAD, and WFP, 2015). Facing these humanitarian needs, international donors and non-governmental organizations (NGOs) provide food aid to improve the nutrition and food security of the poor. According to a 2013 Congressional Research Service report (Hanrahan and Canada, 2013), among the aid providers around the world, the United States contributed 56% of overall food aid shipments during FY1996–2012, making its food aid program the most influential.

Given the significant role of the U.S. food aid program, it is important, especially for policy makers, to evaluate the different aspects of impacts of food aid on recipient countries. Researchers have studied the effects of food aid on economic growth (McClelland, 1998; Clay, Riley, and Urey, 2005), domestic agricultural production (Schultz, 1960; Lavy, 1990; Barrett, Mohapatra, and Snyder, 1999; Abdulai, Barrett, and Hoddinott, 2005; Kirwan and McMillan, 2007), balance of trade (Diven, 2001; Barrett and Maxwell, 2006) and food insecurity in recipient countries (Dercon and Krishnan, 2003; Yamano, Alderman, and Christiaensen, 2005). In this paper, we are interested in examining the effects of food aid on food production. We use food aid data from the U.S. Department of Agriculture (USDA) over the period of 1961–2006 to explore the patterns of U.S. food aid allocation across recipient countries; we then study the average impacts of food aid on food aid production in 118 recipient countries.

Although studies on U.S. food aid have been done for years, no conclusive answer has been reached regarding the impacts of food aid on domestic agricultural production. Food aid has been hypothesized to have disincentive, neutral, or positive effects on domestic

production. Specifically, Schultz (1960) proposed a disincentive effect of food aid on agricultural production since food aid acts as an addition to local food supplies, which could lead to a fall in food price and a depression in the food market. Srinivasan (1989), however, came up with a new hypothesis, stating that there might be a neutral effect of food aid on food production. The adverse effect of food aid is not observable when food aid displaces commercial imports and leaves the level of food supplies unchanged. In 1988, Maxwell and Singer found a positive effect of food aid on production. Countries with an abundance of food aid could reduce food imports and use saved money to import other agricultural resources such as fertilizers, which could lead to an increase in the level of production.

Many things account for the conflicting results, including different methods, data quality, and time span. A commonly used method in the previous literature is vector auto-regression (VAR) analysis. VAR can capture the dynamic relationships between food aid and production because each variable in a particular year depends on its own past values as well as the lagged values of the other variable. However, VAR fails to reveal causality. In addition, most studies use market-level data in a particular country. Although market-level data can account for market-specific characteristics, the interpretation of the results is restricted to the local market only, with no generalizability.

The major contribution of this paper is its use of an instrumental variable method as the identification strategy to study the causal effect of food aid on production. One difficulty in studying causality is reserve causality between food aid and production. To address the issue, we instrument food aid receipts with a three-way interaction term of U.S. wheat stocks, U.S. military assistance, and a measurement of a country's alliance with the U.S. through its voting pattern in the U.N. This instrument significantly captures the variations in the food aid variable, and the identification strategy provides unbiased and consistent estimates.

The other contribution of this paper is its reconciliation of the commodities in FAO production data with USDA food aid data to make sure that close substitutes are included at each aggregation level, that is to say that cereals in production and food aid data contain the same types of grains. This allows us to provide more precise estimations of the impacts. Very

few studies attempt to make production and food aid data comparable, and thus our reclassification approach provides a new angle from which to process production and food aid data for future studies.

As for the main findings, we find that U.S. cereal aid reduces cereal production in recipient countries. If the U.S. doubled food aid, production in recipient countries would reduce by 1.5% on average. To put it another way, when the U.S. increased the amount of food aid by a mean value of 70,832 metric tons, the average reduction in production in developing countries would be around 173,952 metric tons. This disincentive effect of food aid on production is particularly significant for Sub-Saharan African countries, low-income countries, and regular recipient countries of U.S. food aid. However, food aid generates insignificant adverse impact on production when food aid is used for humanitarian needs. In addition, we find that food aid shipments are responsive to donor's political interests as well as recipient countries' needs throughout the past six decades. The U.S. is likely to give food aid to its political allies and countries with military-strategic importance to the United States, especially when the U.S. cereal stocks are sufficient. With regard to recipient countries, populous and poor countries as well as those countries suffering from disasters are likely to receive more U.S. food aid. Importantly, the United States responds to production shortfalls in recipient countries. This finding indicates a possibility of reverse causality between food aid flows and domestic production, and thus justifies the use of the instrumental variable method to isolate one effect from the other in the study of the impacts on production.

Our paper belongs in several branches of literature. First, our study adds new findings on the patterns of food aid allocation. Previous studies cover shorter time periods than the period in this study. Using a dataset with a long time period, our finding that U.S. food aid is driven by both recipient needs and donor interests adds to existing evidence of the altruistic and selfish objectives of food aid (Ball and Johnson, 1996; Eggleston, 1987). Similar to what Young and Abbott (2008) found, patterns of food aid allocation change by regions over the years. Not restricted to only cereal food aid as many papers were (Zahariadis, Travis, and Ward, 2000), we also study the determinants of other types of food aid commodities,

including dry milk powder and soybean oilseeds food aid. The conclusion that U.S. production surpluses partially contribute to shipments of other food aid commodities besides cereals provides additional evidence for the argument that food aid is driven by domestic surpluses (Nunn and Qian, 2014a).

Second, our paper is closely related to a large body of literature that studies the impacts of food aid on production. Different from these empirical studies, which commonly use the VAR method (Lavy, 1990; Barrett, Mohapatra, and Snyder, 1999; Lowder, 2004), our paper is the pioneer, as far as we know, to use the instrumental variable method to examine causal effects of food aid on production.

Lastly, the instrument used in our paper follows the same logic as the identification strategy used in the literature on impacts of foreign aid on economic outcomes. For example, Werker, Ahmed, and Cohen (2008) studied the effects of transfers from wealthy OPEC nations to their poorer Muslim allies. They interacted oil price with a binary indicator for Muslim recipient countries and used this interaction term as the instrument for foreign aid. Similar to Werker, Ahmed, and Cohen's approach, other papers (Nunn and Qian, 2014b; Dreher and Langlotz, 2015) also constructed instruments by interacting one variable that varies across countries with another variable that changes over time. Our instrument follows the same logic as previous studies in order to capture cross-sectional variations in the endogenous variable.

The rest of paper is organized as follows. Section II provides background of the U.S. food aid programs. Section III discusses the literature review of the determinants of food aid allocation as well as the impacts of food aid on production. Section IV illustrates the theoretical framework used in the study of effects on food production. Section V describes the methods, followed by the data descriptions. Section VII covers the results, and VIII summarizes findings and concludes with policy implications.

CHAPTER 2

BACKGROUND

The United States has become a primary food aid donor since the enactment of Agricultural Trade Development and Assistance Act (Public Law 480, or P.L. 480) on July 10, 1954 (Schnepf, 2015). Over the decades, the Unites States has become a leading figure in fighting poverty and improving food security mainly through the provision of food commodities with credit terms or food donations to developing countries. The U.S. food aid system is complicated due to a large number of operating programs, the involvement of many executive agencies, and multiple objectives that the U.S. aid programs seek to achieve. Given the dominant position of the U.S. food aid and its complex nature, it is intriguing to have a close look at the sixty years of history of the U.S. food aid programs by introducing the operating programs, discussing objectives and efficiency, and analyzing patterns and evolution of the U.S. food aid programs.

2.1 Operating Programs

Food for Peace Act (or P.L. 480)

The name of P.L. 480 was the Agricultural Trade Development and Assistance Act of 1954 (P.L. 83-480). President John F. Kennedy named it the "Food for Peace Act" in 1961, but the name of P.L. 480 was not officially changed to the Food for Peace Act (FFPA) until passage of the 2008 farm bill. Table 1 lists all of the food aid programs, the starting date, the managing agency, and information on annual appropriations for main programs since 1960. (Schnepf, 2015)

FFPA consists of four types of aid programs, which are Title I Economic Assistance and Food Security, Title II Emergency and Private Assistance, Title III Food for Development, and Title V Farmer-to-Farmer Program. Title I of the Food for Peace Act is administrated by

the Foreign Agricultural Service of USDA, whereas Title II, Title III and Title V are operated by the United States Agency for International Development (USAID) (Schnepf, 2015). The Congress provides fundings for the programs through annual and supplemental appropriations.

FFPA Title I programs are the concessional credit sales of agricultural commodities provided by the U.S. government to developing countries. The purpose of Title I aid is to dispose of surplus cereals with the goals to reduce the U.S. government storage costs, expand the U.S. export market, and support U.S. farmers. Title I aid is usually sold on credit or grant terms rather than being freely distributed. That is to say, developing countries involved in Title I programs can finance their purchase from the Commodity Credit Corporations (CCC), which is managed by the USDA, through long-term and low-interest rate loans. The transactions of Title I food aid were traditionally made between the U.S. government and recipient governments. In 1996, Private Voluntary Organizations (PVO) and intergovernmental organizations started to participate. After governments or private entities received Title I aid, they typically sell, which is also known as monetize, food aid on the local markets to obtain money for the alleviation of the government's budget deficit, the investments in development programs, or the payment of administrative costs. Title I aid has thus been conceptualized as in-kind balance of payment assistance to recipient governments. In the 1960s and early 70s, Title I food aid came from government-held food surplus stocks. However, the shrinkage in the surplus stocks after the 1970s resulted in cereal purchases from private businesses in the United States by the USDA's FSA through invitations for bids.

Title I of the Food for Peace Act has been controversial since it was enacted, given its explicitly stated purpose of enhancing the U.S. export market. Congressman Brooks Hays and Congressman Page Belcher believed that food aid could promote trade by fostering a preference for U.S. products in recipient countries, and thus enhance food aid recipient countries' dependency on U.S. imports over the long run (Ahlberg, 2009). To foster this objective, one requirement enforced by the United States is to maintain the Usual Marketing Requirements (UMRs) with the provision of food aid. With the concern that the recipient country may displace imports with food aid instead of demanding more imports, UMRs

require the recipient country to maintain exports on the same level as a country's average volume of trade over the past five years. The compliance of UMRs could theoretically impede the displacement behaviors from recipient countries and ensure that food aid flows remain as "additionality" (Deaton, 1980), although not many countries strictly complied with the UMRs in reality. Nevertheless, Title I food aid has been considered as a "disguised export credit program" (Barrett and Maxwell, 2007). Other exporters complained about this because it violated the principle of free trade promoted by the WTO. In addition, the efficiency of Title I aid has been criticized because the FAS has to purchase cereals in an open market at high prices and ship aid via U.S.-flag carriers at a higher than the market rate. Thus, no new funds have been appropriated to Title I since FY2006.

Title II of the Food for Peace Act is different from program aid because it is donated to countries exposed to large-scale disasters in order to meet humanitarian needs. Title II aid consists of two components: emergency assistance to address emergency food needs and nonemergency assistance to address nonemergency economic development needs. The FFPA requires the proportion of nonemergency assistance to be at least 75% of total Title II food aid, but the USAID is authorized to alter this allocation ratio in accordance with actual needs of each type. In fact, the volume of emergency assistance far outweighs the volume of non-emergency aid, which only accounted for 25% of Title II commodities in 2010. (Schnepf, 2015) The United States mainly distributes Title II aid through Private Voluntary Organizations (PVOs), cooperatives, and intergovernmental organizations. The donated commodities come from the inventory held by the Commodity Credit Corporation (CCC), or are purchased on the open market when the stock of inventory runs low. The CCC is responsible for financing commodities, and for reimbursing transportation costs (ocean freight and overland transportation costs) and the distribution costs that are involved when giving out Title II aid. After the governments and other entities received Title II aid, they could sell these commodities on the market subject to the restrictions in the agreement, and then use the proceeds to finance development projects or help nations recover from disasters.

Title III, Food for Development, provides free commodities to developing country

governments that then generally sell the food to fund long-term economic development programs. Title III programs were no longer available after 1999.

Title V, the Farmer-to-Farmer program (FtF), was initially authorized in the 1985 farm bill. The purpose of the Farmer-to-Farmer program is to enhance development in the agricultural sectors in developing countries through the provision of technical assistance to farmers and agricultural organizations.

Other Food Aid Programs

In addition to the four types of aid available under the Food for Peace Act, the U.S. food aid system has five other food aid programs: Food for Progress (FFP), McGovern-Dole International Food for Education and Child Nutrition program (IFECN), Section 416 (b), Bill Emerson Humanitarian Trust (BEHT), and the Emergency Food Security Program (EFSP). Except for Section 416 (b), which was permanently authorized by the Agricultural Act of 1949, other aid programs have been reauthorized in periodic farm bills. (Schnepf, 2015) These four aid programs were recently reauthorized through FY2018 in the 2014 farm bill (P.L. 113-79, the Agricultural Act of 2014).

The Food for Progress (FFP) program commenced in 1985 under the Food for Progress Act, and is administrated by the USDA. Food for Progress aims to improve agricultural infrastructures, technologies and farmer education by donating commodities to developing countries in return for the recipient countries' promise to ease market entry and promote competition in the agricultural sector. The McGovern-Dole International Food for Education and Child Nutrition program (IFECN) was established by the 2002 farm bill. The USDA is the managing agency of the IFECN, which donates commodities to governments, PVOs, cooperatives, and intergovernmental organizations that proceed to sell the food to provide funding for education-related projects. Section 416(b) of the Agricultural Act of 1949 donates commodities in excess of domestic requirements to other countries in order to avoid high storage costs. In 2002, the Bush administration curtailed the use of 416(b) aid and employed the Bill Emerson Humanitarian Trust instead. The Bill Emerson Humanitarian Trust (BEHT)

began in 1980, and is a reserve for food or cash managed by the USDA to provide additional humanitarian needs to developing countries in the case of insufficient aid under FFPA Titles. In 2008, the USDA sold the wheat held in the BEHT and invested funds in low-risk securities to maximize its value. The BEHT has held only cash since FY2013. The Emergency Food Security Program (EFSP) started in FY2010 to provide funds for local and regional procurement of food commodities, cash transfers, and food vouchers to alleviate food insecurity in response of emergencies. The EFSP, which is administrated by the USAID, aims to achieve the same objectives as Title II in-kind food aid but uses different procurement approaches that generally reduce the transportation time. The EFSP is funded by International Disaster Assistance funds and is implemented through PVOs, cooperatives, and intergovernmental organizations. (Schnepf, 2015)

2.2 Efficiency

The U.S. food aid program plays an important role in helping developing countries recover from catastrophes and promote food security. The question of whether the program is effective and efficient is under debate. Concerns regarding the efficacy of U.S. food aid program involve the following three perspectives: multi-objectives of the food aid programs, a large volume of in-kind food aid relative to cash-based food assistance, and the practice of monetization.

Multi-objectives

According to the Tinbergen rule, the U.S. food aid program is ineffective because the food aid program was designed to achieve multiple political objectives. The objectives of U.S. food aid have been generally considered to be a political instrument for achieving "geopolitical, agricultural trade promotion, surplus disposal and poverty alleviation objectives" (Barrett and Maxwell, 2007). However, using one instrument to address these multifaceted goals violates the Tinbergen rule, which stated that optimal policy requires one policy instrument for each

objective. Ruttan (1990) pointed out that using food aid as an instrument to implement multiple goals was an effort to circumvent the Tinbergen rule, which would eventually lead to a lack of success.

In-kind Food Aid Versus Cash-based Food Assistance

Critics argue that in-kind food aid, meaning commodities purchased in donor countries and shipped to recipient countries, is less effective than cash-based food assistance in terms of timeliness of delivery and average cost. Research conducted by GAO (2007) showed that cash-based food assistance can shorten the timeliness required to get food to people by up to 14 weeks compared to traditional in-kind food aid, which usually takes four to six months to ship commodities from U.S. ports to designed destinations. A sample timeline of in-kind food aid delivery from vendor in the U.S. to a village is shown in Table 2. The Kansas City Commodity Office (KCCO) purchases food aid on a monthly basis to allow food orders to accumulate before buying on the market in scale. It then takes roughly three months for the KCCO to collect food and transportation bids and award contracts. Commodity vendors bag the food and deliver it to the U.S. ports for shipment in the next 1 to 2 months. Depending on the distance to the port and the destination, ocean transportation time can vary from two to three months to arrive at an overseas port. There, the food is dispatched to the primary warehouse, from which the food aid is then delivered to villages or targeted households with assistance from the PVOs. This six-month delivery window of in-kind food aid may cause food spoilage or even the loss of lives due to the inability to respond to disasters in a timely manner. In addition, a GAO's study (2007) determined that the peak time for food aid purchases in the U.S. occurs during August and September. This results in the U.S. in-kind food aid failing to arrive in recipient countries during their peak hunger season, which occurs from October to January in Africa, for example. However, cash-based food assistance usually requires one to two months to arrive at destinations, with a considerable reduction in the amount of time required for food procurement and ocean transportation.

Compared with cash-based food assistance, in-kind food aid is more costly due to high

transportation costs (mainly shipping costs) as a result of fulfillment of the Cargo Preference Act, which requires that at least half of U.S. commodity aid must be shipped on U.S. flag vessels. The freight rates on U.S. flag vessels are higher than on counterpart vessels, such as foreign commercial ships. The cargo preference regulation increases the cost of in-kind aid shipments. The shipping expenditures also come from the congressional appropriations, so the available amount of funds for commodities drops as a result of high shipping costs. According to a GAO study (2007), approximately 65 percent of overall expenditures are spent on ocean transportation and other noncommodity costs, such as administration and in-country delivery costs. However, Local and Regional Procurement (LRP) reduced the costs of in-kind food aid delivered to Sub-Saharan African and Asian countries by approximately 30% during the 2001-2008 period, according to a GAO study (2009). This reduction in the average cost of food aid allows aid to reach more people in need.

Given the advantages of cash-based food assistance, one concern regarding the current U.S. food aid program arises from the large proportion of in-kind food aid in the overall program, which involves $1.9 billion (92%) of annual outlays during the FY2006-FY2013 period (Schnepf, 2015). Only the Title V Farmer-to-Farmer and cash-based EFSP programs are cash-based food assistance, whereas the remaining programs involve in-kind food aid. Major donors around the world have shifted from in-kind food aid to cash-based assistance since 2000s. Although the United States started EFSP in 2010, the dominant position of in-kind food aid leads to calls for reform of U.S. food aid, which calls for more flexibility in food procurement in local and regional markets.

Monetization

In-kind food aid is typically monetized by local government or PVOs, and the behavior of selling in-kind food aid in local markets (monetization) is an inefficient use of resources and may distort local markets. One U.S. dollar spent by the U.S. government will lead to less than one dollar of proceeds the local governments or PVOs could receive through monetization due to ocean transportation costs and administrative expenses. In a 2011 study, GAO found that

proceeds generated through monetization are 76% of original costs if the food aid program is administrated by USAID. It is 58% if the administrative agency is the USDA. Thus, a great deal of resources are wasted in the process of monetization. The other issue associated with monetization is the likelihood of market distortion caused by large-volume sales. Without targeting the aid to the population in need, large-volume sales involved in the monetization are likely to depress local markets via lower commodity prices. To prevent or minimize the disincentive effects of food aid on local markets, USAID imposed the Bellmon requirements in 1977. The Bellmon requirements require that U.S. food aid should not be distributed to countries that have inadequate storage facilities or countries that are likely to be negatively affected by food aid. However, the GAO reported that a Bellmon analysis contains a weak market assessment and little or no post-monetization evaluations, and thus does not impede the disincentive effect, if any exists. The Food Aid Reform proposal in the FY 2014 President's Budget suggested an elimination of Title II monetization in order to save about $30 million per year, although this proposal was opposed by PVOs whose costs are largely covered by proceeds from monetization (Schnepf, 2015). Regardless of the obstacles, it is certain that the U.S. food aid reform has begun, with a focus on increasing the flexibility of food assistance delivery and reducing average costs in order to reach more people in need.

2.3 Patterns and Trends

Cereals account for 90.26% of all food aid commodities. They are undoubtedly the primary U.S. food aid commodity. Aggregating the quantity of U.S. food aid delivered to all countries in a given year, Figure 1 shows the total volume of U.S. cereal aid and U.S. non-cereal aid between 1961 and 2006. The quantity of cereal aid far outweighs the quantity of non-cereal aid. Given this figure, it makes sense to focus on cereal aid when analyzing U.S. food aid. In addition to grains, the U.S. also delivers six other categories of commodities. These include animal products, fruits, oilseeds, cotton, vegetables, and tobacco. The relative proportion of each commodity group is shown in Figure 2-1. The volume of oilseed aid comes

in as the second largest, with a percentage of 5.5 of total U.S. food aid. The animals and animal products aid group constitutes 3.1% of total food aid and is the third largest aid commodity category. Tobacco is the least frequently delivered commodity over the period of 1961 to 2006. Among U.S. cereal aid, wheat is the primary donated crop, constituting 71.6% of donations, as shown in Figure 2-2. The second largest cereal group is feed grains, including barley, corn, grain sorghum, cornmeal, rolled oats, and other products. This group accounts for 19.08% of U.S. cereal aid. Rice and blended products are the third and fourth major cereals with proportions of 7% and 3%, respectively.

The variations in the commodity composition of U.S. food aid shipments are moderate from 1961 to 2006. Figure 3 shows the relative proportion of each commodity group during each decade. One obvious trend is that the ratio of grain aid to total aid decreased over time, dropping from 93% in the 1960s to 83% in the 2000s, while oilseed food aid began to grow in importance and became the second largest commodity group. This trend corresponds to the shrinking grain stocks in the United States. Nevertheless, grains remained the main commodities that the U.S. shipped to recipient countries regardless of a slight drop in the relative proportion. As regards the types of cereal aid delivered, wheat is the primary type of grain. Wheat's relative proportion fluctuated between 80% in the 1960s and 58% in the 1990s, and reached 67% in the 2000s, as shown in Figure 4. This fluctuation might be a result of changes in annual aid budget or the prices of grain commodities. In addition, a gradual increase in the proportion of blended products is worth mentioning, shown in Figure 5. Blended products are also known as fortified blended foods (FBFs), which are supplementary to typical grains and legumes. FBFs contain more nutrition than unfortified grains and legumes since FBFs are fortified with essential micronutrients. The pattern of shipping an increasing proportion of food aid in the form of FBFs over time reflects an emphasis on sending nutritious food and improving food aid quality, though the absolute amount of FBFs in the food aid program is much lower than that of wheat.

Over the course of sixty years, the volume of different types of aid programs varies in accordance with the variations in the objectives of the U.S. aid program. Title I food aid was

predominant before the 1970s. After the mid-1970s, the amount of program aid was reduced due to a reduction in stocks, and was replaced by emergency aid, which emerged as the most prominent form of aid in the 1990s. The status of emergency aid was reinforced when the 1990 farm bill explicitly stated the promotion of food insecurity as one primary objective of food aid. However, because of the limitations of our data set, we are unable to plot the variations in the different aid programs over time. Aggregating the amount of in-kind food aid, Figure 1 demonstrates the trends over time for total U.S. cereal aid.[1]The U.S. cereal aid shipments dropped dramatically in the early 1970s because of a reduction in food stocks caused by the world food crisis. Then, U.S. cereal aid grew steadily and peaked in the early 1990s. Together with the drain in the cereal surpluses, food aid shipments fell to historical lows during the mid-1990s.

In addition, U.S. food aid shipments vary a great deal by region and are closely aligned with U.S. political interests in particular regions. Figure 5 demonstrates the changes in the amount of aid delivered to six regions over time. In the 1960s and the beginning of the 1970s, the United States allocated considerable tons of food aid to South Asia, where many countries were swinging back and forth between capitalism and communism. In 1973, the world food crisis erupted. African countries were hit badly and also became recipients of U.S. food aid. In the mid-1970s, the U.S. shipped aid to Middle Eastern countries in response to the oil embargo, which began in 1973. The U.S. continued sending aid in the 1980s to Middle Eastern countries to claim its interest in these countries' natural resources. After the end of the Cold War, the U.S. escalated food aid shipments to Europe for the purpose of alleviating the tense relationships with the former Eastern Bloc countries. Since the late 1990s, most food aid has gone to Sub-Saharan African countries, which suffer severely from a variety of natural disasters and chronic poverty. This trend corresponds with the fact that emergency aid has outweighed other types of food aid since the 1990s up to the present day.

The variations in the amount of U.S. food aid assistance are apparent by regions over time, as are the variations in the top destinations within each region. Figure 6 contains two

[1]Despite the best effort, we still could not get food aid data in 1990 and 1991.

treemaps, which show the accumulated amount of aid received by countries in each region using nested rectangles prior to 1990 and after 1990. The size of the rectangle is proportional to the quantity of aid, and the color ramp represents the absolute value of U.S. cereal aid received by countries, ranging from 0 on the left of the ramp to the highest value on the right of the ramp, corresponding to white and navy blue, respectively. The graphs show that the top destinations for aid have changed significantly. Before 1990, India and Pakistan in South Asia, Egypt in Middle East and North Africa, Brazil in Latin America and Caribbean, Sudan in Sub-Saharan Africa, and South Korea in East Asia and the Pacific received the greatest amounts of aid in each of their respective regions. South Asia was the most popular region for aid shipments, and European and Central Asian and Sub-Saharan African countries received relatively less food aid. However, the proportion of aid delivered to South Asia plummeted after 1990, and a significant proportion of aid went to Europe and Central Asia, particularly to Russia and the former Soviet Union. In addition, a rise in the distribution of aid to Sub-Saharan African countries indicates a shift in the objectives of aid programs toward a focus on the alleviation of food insecurity. Compared with recipient countries before 1990, the destinations were more widespread within regions after 1990. The top destinations to receive food aid during the 1990-2006 period were Ethiopia and Eritrea in Sub-Saharan Africa, Russia in Europe and Central Asia, Peru and Bolivia in Latin America and the Caribbean, Bangladesh in South Asia, Yemen in Middle East and North Africa, and Pakistan and Indonesia in East Asia and the Pacific.

CHAPTER 3

LITERATURE REVIEW

A vast body of literature has emerged on U.S. food aid-related topics since the food aid programs began in 1954. The economic literature on food aid covers two main topics: determinants of food aid allocation and the socio-economic impacts of food aid. The results show a mix of positive and negative evidence of the impacts of food aid on developing countries due to various analytical methods and data used. Nevertheless, these theoretical and empirical studies provide researchers and policy makers insights into the overall efficiency and effectiveness of the U.S. food aid programs. In this section, we will discuss the literature on the factors that affect aid allocation as well as the impacts of food aid on recipient-country production.

3.1 Determinants

As for the determinants of U.S. food aid, theoretical and empirical researchers agree that determinants are either from donor countries' own objectives or from recipient countries' needs, or both. In summary, the factors can be a combination of humanitarian interests, economic interests, political objectives, and export market promotion goals. Papers in this branch of literature examine various factors that could exert an influence on aid volume and aid distribution, such as stocks of food commodities in donor countries (Nunn and Qian, 2014a; Diven, 2001), colonial past (Alesina and Dollar, 2000), voting patterns in the U.N. (Alesina and Dollar, 2000), antagonism of communism (Boschini and Olofsgard, 2007), donor countries' interest in Middle East (Alesina and Dollar, 2000), U.S. military presence (Meernik, Krueger, and Poe, 1998), trade and economic development (Poe and Meernik, 1995), production shocks in recipient countries (Nunn and Qian, 2014a), catastrophes in recipient countries (Canavire Bacarreza et al., 2005), and the level of democratization in recipient countries (Alesina and Dollar, 2000).

The driving factors underlying U.S. food aid shipments have not been static or monotonous over the past sixty years. Eggleston (1987) concluded that U.S. food aid allocation considered both recipient needs and U.S. political and military interests from 1955-1979. Shapouri and Missiaen (1990) studied the patterns of U.S. food aid allocation over the period of 1975 and 1985. They found that the factors that affected aid giving in Eggleston's study were still significant from 1975 to 1985. In addition, the donor interests in the form of export promotion became a significant determinant of U.S. food aid allocation. Ball and Johnson (1996) also studied several competing objectives of U.S. food aid policy and whether the motivations changed during the period of 1971-1990. They concluded that U.S. food aid shipments in the 1970s were served to fulfill its own economic and strategic interests, but humanitarian concerns started to be factors driving U.S. food aid shipments in the 1980s. In addition, Ball and Johnson (1996) found that objectives for different types of food aid were also different. Political factors, such as U.S. exports of arms and voting similarity at the UN, were more important in determining Title I food aid than humanitarian considerations. In contrast, humanitarian factors were significant, but political variables were insignificant in the allocation of Title II food aid. The allocation patterns across titles were consistent with the stated objectives.

Other literature studied several donor countries to compare different objectives that have driven aid allocation. Alesina and Dollar (2000) found that determinants of giving aid diverge a lot between donors. Specifically, the Nordic donors were likely to reward countries with democratic institutions and free trade policies. The United States's pattern of aid giving is closely related to its interest in the Middle Eastern countries. Berthélemy and Tichit (2004) used a rich dataset with coverage of 22 donors and 137 recipients from 1980-1999. They constructed a three-dimensional panel analysis to allow for comparisons among donors over time. They concluded that formal colonial links had a positive influence on aid allocation policies for all donors. Many donors, for instance the U.S. and Australia, rewarded good economic performances after the Cold War. The focus of this paper is on the U.S. food aid programs, so the literature on aid distribution behaviors from multiple donors will not be

vastly expanded.

Although many papers have studied the factors that cause cross-country differences in terms of volumes of U.S. food aid received, very few papers take the censored nature of the variable food aid into consideration. As Dudley and Montmarquette first stated in 1976, the process of general aid allocation involves two steps: choosing the eligible countries and determining how much aid to allocate among recipients. Zahariadis, Travis, and Ward (2000) applied the two-stage process to food aid and studied U.S. food aid allocations to African countries from 1978 to 1990. The value zero of the dependent variable represents a choice made by the donor, and thus running the linear estimation using the sub-sample (countries that received positive aid) could yield biased estimates. In order to minimize selection bias, we will use Chamberlain's random effects tobit model. In addition, this paper contributes to the existing literature by estimating determinants of U.S. food aid on a rich dataset covering the period of 1961-2006. This allows us to see which factors play a role in shaping U.S. food aid allocation, and how the importance of each factor changes over time across regions. These results are useful to provide an insight about the U.S. food aid programs, and build a foundation upon the second part of analysis on the consequences of food aid on food production.

3.2 Effects of Food Aid on Production

The study on food aid has been discussed since 1960, only a few years after the enactment of food aid laws, but researchers have not reached an agreement on the impact of food aid on agricultural production. The results vary a lot depending on methodology, data quality, time span, and the set of countries. In general, qualitative studies are more likely to conclude that food aid may have a disincentive effect on domestic production through the following channels, such as reduced domestic food prices, a change in government's policy in agriculture, and a distortion in labor supply. Empirical studies, however, rarely have sufficient evidence to conclude a negative relationship between food aid and food production. The

quantitative studies focus on either the household- or nation-level, and methodologies are different depending on whether the study is static or dynamic. It is more prevalent to observe a slightly positive effect of food aid on production at the household level while the neutral relationship is commonly found in the across-country analysis.

Schultz (1960) was the pioneer to evaluate the implications of food aid policy on underdeveloped economies. Specifically, he speculated an adverse effect of P.L. 480 aid on agriculture in the receiving countries because food aid acts as "additionality" to local food supplies, which could lead to a drop in local food prices and a corresponding depression in the food market. The validity of analysis is based upon one crucial assumption: the country strictly complies the Usual Marketing Requirements (UMRs), which is to maintain the same level of imports from the United States regardless of the volumes of food aid received. However, the literature shows that the UMRs are not strictly enforced (Maxwell and Singer, 1979; Fitzpatrick and Storey, 1989; Barrett, Mohapatra, and Snyder, 1999; Von Braun and Huddleston, 1988). Specifically, Barrett and Heisey (2002) estimated that up to 60-80 percent of the imports would be replaced by food aid in recipient countries. In addition, the focus of Schultz's study was mainly on P.L. 480 Title I food aid, which took up a considerable proportion of the food aid program in the 1960s and 1970s. The dramatic changes in the proportion of various types of aid programs in the following years make it appealing to examine the impacts of other titles of food aid on agricultural production.

In 1963, Fisher refined Schultz's study by providing a rigorous framework with a remarkable conclusion. He suggested that food aid might have a non-negligible income effect on receiving countries when the governments monetize the commodities and use funds to support domestic agriculture or economic development. Although food aid inflows might reduce domestic prices as proposed by Schultz in 1960, this disincentive effect might be mitigated as the long-run positive income effect plays a role to offset the negative impact of food aid on the agricultural market. Acknowledging the existence of both disincentive and income effects of food aid, Fisher's study fairly explains the root of the unsettled debate on the impacts of food aid. However, Doriye, White, and Wuyts (1997) found in a empirical study in

Tanzania that the recipient country's government did not use the monetized funds from food aid to increase government expenditure but to offset the trade deficit. This finding poses a concern regarding the existence of the long-term positive income effect of food aid.

Barrett and Maxwell (2006) looked at the impacts of food aid on food prices from the households' perspective and determined the possible existence of disincentives of food aid to domestic production. They interpreted the pressure on local food prices as a result of unbalanced demand-supply relationships, and the pressure was especially high when the trade in that country was close to the outside markets. In their argument, the provision of food or cash could be considered as a transfer of income. For households, food aid was equivalent to an income effect on the demand for food, which might give them more purchasing power to buy a higher quantity of food that they would not be able to afford without the extra income caused by food aid flows. Thus, the provision of in-kind food aid increases the demand and supply of food. Based on the logic of Engel's law, which states that the income elasticity of demand for food is less than one, the increase in the income is greater than the increase in the demand for food. This indicates that supply grows faster than demand, and thus creates the demand-supply imbalance. As a result, the consequence associated with the demand-supply imbalance is a reduction in prices. The extent of the reduction in price depends on the elasticity of demand for food as well as the elasticity of supply for food in the empirical studies.

In addition to the price mechanism that may discourage production, Maxwell and Singer (1979) argued that a depression in agriculture associated with food aid might come from a change in governments' willingness to make policy reforms and communities' behavior in implementing development projects. For example, Salisbury (1992) reported that Ethiopians intended to plant trees upside down in a FFW project to encourage the ongoing food aid assistance. Groupe (2005) reported that some communities in Afghanistan stopped maintenance on public goods due to an anticipation of food aid flows on the same projects. These behaviors are called community-level moral hazard, imposing an adverse effect on market by taking more risk (Barrett and Maxwell, 2006). In addition, the availability of food

aid may give excuses to local governments to postpone policy reforms in agriculture. This situation is also called the Samaritan's Dilemma. This states that an anticipation of ex-post relief may crowd out the government's willingness to implement policy reforms, which would have been done if there were no aid assistance. In Raschky and Schwindt's study (2009), they examined whether an anticipation of ex-post assistance crowded out government's protective actions in a response of storms, floods and earthquakes between 1980 and 2002. They found that the crowd-out effect outweighed the protective effect for storms. If the local government heavily relied on food aid, postponements of policy reforms or reductions in agricultural investment would lead to stagnation in economic growth.

Another possible path through which food aid may adversely affect agricultural production is household labor. Specifically, two types of distortions are possible: one is the labor income effect; the other is the labor substitution effect, which only applies to the food-for-work (FFW) program. Since the provision of aid or cash is equivalent to an income transfer, the labor income effect states that workers with higher income would prefer to reduce their working hours, as the fundamental microeconomic theory predicts. Thus, food aid may discourage local producers to farm, which may result in a reduction in food production. Furthermore, the empirical evidence shows that labor supply became more responsive to income changes when households are wealthier. This indicates that the labor disincentive effect is greater when the aid flows go to wealthier families who are more likely to transfer extra income to leisure instead of production. The labor disincentive effect is mitigated when the food aid is targeted towards the most need recipients. The other type of labor distortion occurs when the high payoff of the food-for-work (FFW) programs encourages workers to switch from local agricultural businesses to food aid-based programs. This substitution behavior leads to a reduction in labor inputs in local food production, theoretically causing an adverse impact on agriculture production. However, things can get complicated in reality. As Holden, Barrett, and Hagos (2006) stated, FFW programs could generate immediate or short-term benefits to local food production, even though this positive effect might be offset by medium to long-term labor disincentive effects.

The previous literature provided speculation on three mechanisms of how food aid affects food production. Admittedly, government policy and labor input are important channels through which the impacts of food aid on production occur. The main debate has focused on the price effect of food aid. The theoretical studies provided ambiguous conclusions as to whether food aid reduced food price, and thereby decreasing domestic production. The lack of consensus makes it necessary to resort to empirical tests.

The empirical evidence of the disincentive effects of food aid on food production is relatively thin. Tschirley, Donovan, and Weber (1996) studied the effects of yellow maize food aid on maize production in Mozambique. They used monthly arrivals of food aid data and monthly retail market prices of yellow and white maize in the capital Maputo from March 1990 to January 1995. They found the evidence of a fall in market price of maize which was caused by an inflow of commercial and emergence yellow maize. This price effect penetrated to white maize, which is a substitute of yellow maize, and other contingent markets outside Maputo. This finally caused a depression in incentives of maize producers. Being consistent with Schultz's concerns, Gelan (2007) also supported the existence of disincentive effects of food aid but from a different perspective. He used a computable general equilibrium model to prove a modest increase in food prices and a growth in food production as much as 2.2% with a removal of food aid in Ethiopia. In addition, Tadesse and Shively (2009) concluded a negative impact of food aid on food prices using a system of seemingly unrelated regression model with monthly data from three local markets over the period 1996-2006 in Ethiopia. This negative impact of aid shipments on food prices only applied to internationally traded goods. Importantly, they argued that the corresponding adverse influence on production caused by a reduction in prices was observable when the food aid accounts for more than 10% of local production. Food aid shipments with quantities below this threshold tended to be benign. Although this cut-off has little generalization power, Tadesse and Shively's study provided an insight of complexity in which the effect of food aid could be subject to the characteristics of local markets. Some of these characteristics are easily to control for, such as the relative proportion of food aid over total production, while others are much harder to be captured in the

model. If we failed to controlled for these characteristics, the results would be problematic and misleading.

After Tadesse and Shively's publication, several researchers also addressed the importance of controlling for confounding effects and emphasized how misleading the statements would be if the model were not well specified. Dayton and Hoddinott (2004) examined if there were disincentive effects of food aid on household behaviors in rural Ethiopia in the 1990s. Simple test statistics supported the existence of disincentive effects on households. Food aid reduced labor supply, crowded-out private transfers, and created dependency in the long run. However, when the authors took households' characteristics into consideration, adverse effects disappeared. On the contrary, the results showed that food aid led to an increase in labor supply to agriculture. Similarly, Abdulai, Barrett, and Hoddinott (2005) found that the effects of food aid on production in Africa turned from negative under the OLS regression to positive once the confounding factors were considered.

Bearing the importance of correct specification in mind, it is also important to be aware of government's role in determining the effects of food aid. Mann (1967) found that food aid significantly reduced food production in India. Several years later, Isenman and Singer (1977) also studied the impacts of food aid on production in India, and the disincentive effects reduced dramatically due to the successful implementation of food distribution policy. In addition, Hall (1980) showed that P.L. 480 wheat imports had a positive impact on grain production because government used excess revenue gained from the food aid to support domestic grain producers. Recently, Bezuneh, Deaton, and Zuhair (2003) used a system of equations to estimate the short-term effects of food aid on the economy of Tunisia for the period of 1960-1992. They found that the active role of the government in domestic pricing was a key contributor to domestic production and economic growth. The disincentive effects of food aid were minimized through appropriate public policies.

Other scholars are not convinced by the significant impact of food aid on production. Little (2008) argued that few farmers could alter their production behavior because food aid delivery was too uncertain and poorly timed. Thus, he did not find significant impacts of

food aid on production in Northeastern Ethiopia from 1999-2000 and 2002-2003. Mabuza et al. (2009) looked at the maize market in Swaziland from 1985-2006, and could not find the empirical evidence that food aid lowered prices of maize or affected maize production in the subsequent years using the reduced form market equilibrium model.

The preceding studies have different answers as to whether food aid has a disincentive, positive or neutral effect on food production. To have a broad idea of how the world has been affected, we should discuss the impact of food aid from the cross-country analysis. Compared to the market-level analysis for specific countries, the multi-country analysis is relatively meager due to the obstacles in terms of data acquisition and econometric methods. Data for developing countries over a long time period is hard to obtain, and the reliability of data is under suspicion. The likely misspecification of econometrics model another concern, which can lead to biased results. Nevertheless, the multi-country empirical studies provide valuable results that are applicable to many potential recipient countries. This makes it meaningful to look at the effects of food aid on production from a global perspective.

Similar to the results of the market-level or household-level studies, no conclusive statement regarding the effect of food aid has been made using national level data. Barrett, Mohapatra, and Snyder (1999) pioneered to study the dynamic effects of US food aid on eighteen countries over period 1961-1995. The paper applied structural vector autoregression method to examine the dynamic relationships between food aid, production, and trade. They found a J-curve effect of food aid on trade volumes in recipient countries, meaning that commercial transactions initially decreased before increasing in the long run. However, the effects of aid on production were very modest. Although food aid seems to have neither stimulative nor disincentive effects on production in the long run, Barrett, Mohapatra, and Snyder (1999) stated that food aid had an initially negative impact on production through the adverse influence on prices, but soon recovered. This was possible because the recipient countries reduced the balance-of-payments due to the food aid inflows, and thus could increase the imports of durable inputs (e.g. machinery or fertilizer). However, the data in this paper only involved program food aid, which was only a small proportion over the total food

aid in the 1990s. In 2004, Lowder made an improvement upon Barrett's study by using both program and targeted (humanitarian) food aid from the International Food Aid Information (INTERFAIS) data from 1988 to 2000 covering 64 countries. Using a dynamic structural equation model, Lowder (2004) found that neither targeted nor program food aid affected food production. When restricting the sample to Sub-Saharan African countries, Abdulai, Barrett, and Hoddinott (2005) studied 42 African countries from 1970-2000. They found that any disincentive effects caused by depressed product prices were offset by positive influences on balance of payments and exchange rates. Lavy (1990) also found a significant positive effect of food aid on local production in Sub-Saharan Africa using the VAR approach, but did not explain much why the positive effect would happen.

A common drawback in the multi-country studies is that they fail to address endogeneity problem of food aid. In the papers that used VAR, they used the lagged food aid variables as instruments for endogenous variable food aid, but this could not fully solve the simultaneity problem. The results under the VAR method mainly reveal correlations. To learn more about the direction and magnitude of the relationships between aid and production, we will use the instrumental variable method in this paper to study whether whether US food aid has any impact on local production. Another contribution of this paper is to use the USDA food aid data from 1961-2006. Most cross-country papers use the INTERFAIS data and do not cover such a long time period. In addition, this paper reconciles the commodities in FAO production data with USDA food aid data to make sure that exactly the same commodities are included at each aggregation level. This allows us to provide more precise estimations.

CHAPTER 4

FRAMEWORK

The conceptual framework in studying the effects of food aid on production is built upon the partial equilibrium models, and we follow Lowder's approach (2004). An important factor to explore the possible impacts on production is the degree of displacement of imports caused by food aid. In general, a full displacement would leave domestic supply unchanged, whereas a partial displacement would increase supply by a magnitude proportional to the extent of displacement. One important factor that could determine how much food aid displaces imports is the type of food aid. Three main aid programs are of interest and are divided into two categories based on intrinsic characteristics: one is the non-targeted food aid, comprising program food aid; the other group is the targeted food aid, comprising project and emergency food aid. The difference between non-targeted and targeted food aid is whether food aid is targeted to intended beneficiaries. One thing to note is that the non-targeted program food aid is subject to the UMRs, which were introduced by the Consultative Sub-Committee on Surplus Disposal (CSSD) and aimed to prevent imports displacement. Targeted food aid is not subject to the UMRs.

Figure 7- 11 show the effects of food aid on production using a supply-demand model for non-targeted and targeted food aid programs, correspondingly. In general, the effects of program food aid on production are negative or neutral, while the effects of targeted food aid are neutral or even positive under certain circumstances. The following paragraphs will discuss different scenarios for each type of the food aid programs given various degrees of UMR enforcement and the extent of import displacement.

A few assumptions are necessary to make sure the theoretical model is sound. First, we assume that the U.S. food aid commodities are perfect substitutes for the local commodities. In addition, we assume a three-country world, with one importer, one donor and one exporter. The recipient country is the importer, who imports food from the exporter and receives food

aid from the donor. As for the donor, the United States in our case, also exports commodities to developing countries. So we assume that the donor and exporter is the same country. The exporter has comparative advantage in food production, and can produce food at a price below the world price P_E. The quantity of food aid delivered by the donor is equal to Q_{FA}, and the quantity of commercial exports is equal to Q_I.

For program food aid, three situations are possible.

1. A successful enforcement of UMRs leads to a full additionality of food aid on domestic supply. S_t inceases by Q_{FA}. An excessive supply of food decreases the price of food, which discourages food production.

2. An unsuccessful enforcement of UMRs leads to a partial displacement of imports. S_t inceases by $Q_{FA} - Q_{Displacedimports}$. A market surplus results in a reduction in the food price. A lower price of food discourages production, but to a lesser extent compared with the first situation.

3. An unsuccessful enforcement of UMRs leads to a full displacement of imports. S_t remains stable. Food aid will not affect production.

To put it in detail, a successful enforcement of UMRs means that the government in the recipient country has to purchase the pre-determined quantity of imports (Q_I) at the pre-agreed price (P_E), shown in Figure 7. An inflow of food aid increases domestic supply S_t by Q_{FA}, leading to a reduction in the domestic price. A lower price of the food commodity may discourage farmers from producing food. Some farmers could be driven out of business when the revenue made at P_N is not enough to cover costs. Others who stay in the market may reduce the amount of resources, such as labor inputs. Either situation would lead to a drop in food production. It is also possible, in the long run, that the government may hesitate to fund agricultural investment or to push policy reforms arising from a low level of production. This unsupportive behavior to agriculture from the government would aggravate the negative effects of aid on production. As a result, the country would become highly dependent on food aid if the decrease in domestic production were large or lasted a long time.

In reality, a successful enforcement of UMRs rarely happens. The recipient government generally does not strictly comply with the import quantity and price determined in the UMRs. Depending on the price at which the recipient country's government resells the program food aid, a partial displacement of imports or even a full displacement would happen. Figure 8 depicts a situation where food aid partially displaces imports. Since the displacement of imports with food aid occurs, the recipient country imports less food compared to the quantity of food imported under the enforcement of UMRs, which means $Q_I{}' < Q_I$. This leads to an increase in food supply S_t by an amount less than the extent at which food aid is fully additional. Without the government's intervention on the price, food aid drives down the price to $P_N{}'$. Compared to Figure 7, the reduction in the price is smaller due to the import displacement. Again, this causes a disincentive effect for producers but to a lesser extent. If the government decides to protect domestic food producers and resells food aid at the world price P_E, the imports will be fully displaced by food aid ($Q_I - Q_I{}'' = Q_{FA}$), as shown in Figure 9. Domestic supply S_t remains stable since food aid is offset by the reduction in imports. The total consumption of food comprises of food aid Q_{FA} and the new quantity of imports $Q_I{}''$. In this case, production will not be affected by food aid.

For targeted food aid, we will discuss different scenarios for project and emergency food aid programs. Project food aid is non-emergency in nature, which provides consistent assistance for nutrition enhancement programs. Given that project food aid is free of charge, project food aid can be considered as a transfer of income. That is to say, project food aid is equivalent to an increase in the households' income, which is captured by an outward shift in the demand curve, as shown in Figure 10. For households, regardless of how poor they are, the income elasticity of demand for food is greater than zero and less than one.[1]It means that households consume less than one dollar of food for every one-dollar increase in the income. This shifts the demand curve by a magnitude of $\varepsilon_i Q_{FA}$ to the right, where the ε_i is the income elasticity of demand for food in country i. Since only a proportion of total food aid is demanded by people, $(1-\varepsilon_i)Q_{FA}$ remains as the unconsumed amount, which is the total leakage of food aid that flows to the market. $(1-\varepsilon_i)$ measures the extent of leakage. If the amount of food

aid that flows to the market $(1-\varepsilon_i)Q_{FA}$ fully displaces imports, the total amount of imports reduces by $(1-\varepsilon_i)Q_{FA}$. Domestic supply remains stable, and production is not discouraged unless the amount of leaked food aid $(1-\varepsilon_i)Q_{FA}$ is greater than Q_I. If the amount of food aid that flows to the market partially displaces imports, domestic supply increases by a small amount, which is the difference between $(1-\varepsilon_i)Q_{FA}$ and the amount of imports displaced. This increase in S_t may lead to moderate disincentive effects or most likely neutral effects due to the small magnitude in the increase of food supply.

As for the emergency food aid, the situation is slightly different from that under the project food aid. Similar to project food aid, emergency food aid is considered as a transfer of income since the recipient government received the aid for free, shifting the demand curve to the right, as shown in Figure 11. However, the delivery of emergency food aid is usually responsive to natural disasters, which presumably have caused a huge negative impact on domestic production before the arrival of aid. This fact leads to a shift in the supply curve to the left for emergency food aid, being different from the change in the supply curve for project food aid. Since the amount of food aid delivered is generally less than the reduction in production caused by disasters, the supply curve for the recipient is S_i'', resulting in $Q_{EI}{}'$ as an extra amount of imports compared to the original import level Q_I. Again, $(1-\varepsilon_i)Q_{FA}$ is the amount of aid that flows to the market. If the unconsumed quantity of food aid $(1-\varepsilon_i)Q_{FA}$ is equal to $Q_{EI}{}'$, the recipient imports food at the original amount Q_I. Domestic supply S_t remains the same, and thus there is no disincentive effect for farmers. However, it is more likely that $(1-\varepsilon_i)Q_{FA}$ is less than $Q_{EI}{}'$, which requires the government to increase imports by $Q_{EI}{}' - (1-\varepsilon_i)Q_{FA}$ in order to maintain the same consumption level as before the disaster. If the recipient's government fails to fulfill the demand, food supply in the current year would be in shortage. As a result, local farmers may be motivated to increase production in the following year.

[1]The income elasticity of demand for food is highest among low-income countries, according to the World Bank Report (2012). For example, the income elasticity of demand for food was 0.85 in the Democratic Republic of Congo and was 0.71 in Armenia in 2012.

CHAPTER 5

METHOD

In this section, we talk about the econometric methods used when studying the patterns of U.S. food aid allocation and the impacts of food aid on production, respectively. To take the corner solution outcome into account, we decide to use a tobit model to examine U.S. food aid allocation. We then provide statistical evidence on unbiasedness and consistency of the tobit estimator. With regard to the effects of food aid on production, the instrumental variable method is adopted to account for simultaneity bias. We thoroughly discuss the internal validity of the instrument, followed by a statistical illustration of the IV approach.

5.1 Determinants

Since the U.S. ships food aid only to targeted countries, the sample contains many zero food aid flow observations. With many dependent variables equal to zero, the dependent variable in our case is a corner solution. Ordinary least-squares (OLS) regression can not generate consistent parameter estimates, as the observed sample is of limited usefulness for inference about the entire population. Two methods are used to estimate this model from the previous literature.

The first method is the two-part model, which is used to replicate the two-stage decision making process (Dudley and Montmarquette, 1976). In the first stage or gate-keeping stage, the U.S. has to decide to whom to allocate food aid, which is equivalent to a Probit model that determines the probability of receiving aid. During the second stage, the U.S. has to decide how much food aid goes to each eligible country, which can be estimated by a linear model using the sub-sample of positive aid observations.

The second method is the tobit model, which estimates the patterns of aid allocation in one step. The aid allocation is an outcome of the maximum of zero and a linear function of independent variables. The estimation is conducted in one step, so that we assume that the

factors that determine the probability of obtaining food aid are the same as the factors that determine the amount of food aid in the allocation.

In this paper, we use the tobit model as the main method because a strict assumption of the two-part model is that the choice of the recipient country is independent from the amount of aid allocated to that country, meaning that the errors terms in each of two stages are unrelated. This assumption generally does not hold since the decisions at the first stage are relevant to the decisions made later on regarding the amount of aid. The violation of this strict assumption will introduce a selection bias in the second step.

The tobit model gives unbiased and consistent estimators, and this paragraph will provide statistical evidence. [1] We define the variable y^* as a latent variable that is a linear function of x_i, and it can be expressed as: $y_i{}^* = x_i\beta + \varepsilon$, $\varepsilon_i \sim (0, \sigma_u{}^2)$. Assume the variable y_i is observed if $y_i{}^*$ is greater than zero; otherwise, and variable y_i is equal to zero. For the corner solution case, we observe the latent variable $y_i{}^*$, but we are interested in properties of the distribution of y_i, which is the conditional distribution of $y_i{}^*$. The expected value of the variable y_i is shown as:

$$\begin{aligned} E(y_i|x_i) &= E[y_i{}^*|y_i{}^* > 0, x_i] \cdot P(y_i{}^* > 0|x_i) + P(y_i{}^* = 0|x_i) \cdot 0 \\ &= E[y_i{}^*|y_i{}^* > 0, x_i] \cdot P(y_i{}^* > 0|x_i). \end{aligned}$$

Since ε is normally distributed,

$$\begin{aligned} E[y_i{}^*|y_i{}^* > 0, x_i] &= x_i\beta + E[u|u > -x_i\beta] \\ &= x_i\beta + \sigma E[\frac{u}{\sigma}|\frac{u}{\sigma} > \frac{-x_i\beta}{\sigma}] \\ &= x_i\beta + \sigma[\frac{\phi(x\beta/\sigma)}{\Phi(x\beta/\sigma)}] \\ &= x_i\beta + \sigma\lambda_i, \end{aligned}$$

where λ_i is known as the inverse of Mills Ratio. ϕ represents the probability density function (pdf), and Φ denotes the cumulative density function (cdf). We assume that $P(y_i{}^* > 0|x_i) =$

[1] Here we use the same notation as Wooldridge did in his book (2010).

$[1-\Phi(-x_i\beta/\sigma)]$. Plugging this equation into the equation of the expected value of the variable y_i, we can get:

$$\begin{aligned} E(y_i|x_i) &= (x_i\beta+\sigma\lambda_i)\cdot[1-\Phi(-x_i\beta/\sigma)] \\ &= (x_i\beta+\sigma\lambda_i)\cdot\Phi\frac{x_i\beta}{\sigma}. \end{aligned}$$

The equation above shows that the expected value $E[y_i|x]$ is a nonlinear function of x. The OLS estimator is biased and inconsistent compared to the tobit estimator. The maximum likelihood method is then used to estimate the model.

One of this paper's objectives is to examine the factors that determine the U.S. food aid shipments and how these determinants vary across regions and over time. Given our interest, we specify the following model:

$$Y_{it} = max(0, \alpha+\beta X_{it}+\gamma_i+\lambda\delta_t+\varepsilon_{it}) \tag{5.1}$$

$$\varepsilon_{it}|X_{it},\gamma_i \sim (0,{\sigma_u}^2)$$

where Y_{it} is the log of food aid quantity with a value of one added to preserve observations. X_{it} is a vector of variables determining food aid. γ_i represents country unobserved heterogeneity. δ_t is the time trend, and ε_{it} is the idiosyncratic error term.[2] However, we cannot control for country specific effects (γ_i) by including country fixed effects in the tobit model due to the incidental parameters problem (Greene, 2004). Alternatively, we use the random effects tobit method, which is the approach adopted by Young and Abbott (2008), Berthélemy and Tichit (2004), and Canavire et al. (2006). A strong assumption of the random effects model is the independency of X_{it} and γ_i, which is too difficult to satisfy. To relax this restrictive assumption, we use the Mundlak-Chamberlain approach (Chamberlain, 1982; Mundlak, 1978) and specify unobserved heterogeneity between recipient countries γ_i as a function of

[2]We control for time trends instead of time fixed effects due to the independent variable *cereal production in the U.S.*. The variable *cereal production in the U.S.* only varies over time so that time fixed effects would capture all variations in this variable. Alternatively, we use time trend variables to control for factors that consistently affect food aid distributions over time, such as global price shocks.

observables, $\gamma_i = \phi + \bar{x}\psi + \upsilon_i$. The assumption of the Mundlak-Chamberlain approach, which assumes that unobserved heterogeneity γ_i is an explicit function of the means of x variables, may be restrictive. This approach at least relaxes the assumption of exogeneity between regressors and γ_i under the traditional random effects tobit model.Now, we can rewrite our model as

$$Y_{it} = max(0, \alpha + \beta X_{it} + \phi + \bar{x}\psi + \upsilon_i + \lambda\delta_t + \varepsilon_{it}) \tag{5.2}$$

$$\varepsilon_{it}|X_{it}, \upsilon_i \sim (0, {\sigma_u}^2)$$

After adding individual means of time varying x-variables to to regression, we allow for non-zero correlation between the random effects and the regressors.

As for the explanatory variables, we examine the determinants of food aid from two aspects, supply-side factors from the donor's perspective and demand-side factors from the recipient's perspective. For the donor country, the United States for instance, the political and strategic consideration comes first. We use the variable *alignment* that measures countries' voting similarity in the U.N. with the U.S. as a proxy for that country's political alliance with the U.S. It is generally believed that it is very likely for donors to give aid to their allies. We include the U.S. military aid variable to see whether donors give preference to countries with military-strategic interest. We also control for population, as the amount of food aid grows with the size of a country. In addition, since the U.S. food aid program is initiated with the objective to dispose surpluses, the decisions on food aid shipments are related to the food production in the U.S. We control for cereal food production in the U.S. to address the possibility that more food aid is distributed when production in the U.S. is sufficient.

From the recipient country's perspective, humanitarian concerns or recipient's needs are considered as main forces driving the U.S. to ship food aid. Specifically, we include a country's *income level* and *GDP per capita* to see if the U.S. ships food aid to the poor countries that are in need of aid. We also include a dummy variable *lagged conflict* to indicate whether a country is suffering from conflict. This variable can be used to measure if the U.S. responds to disasters that occurred in recipient countries. Finally, we control for the food production level in the

recipient countries to study if production shocks are factors that affect food aid allocation.

5.2 Effects of Food Aid on Food Production

We are also interested in studying the impact of food aid on food production. The regression specification is shown below,

$$Y_{it} = \alpha + \beta Aid_{it-1} + \lambda X_{it-2} + \tau_i + \varphi_t + \varepsilon_{it} \tag{5.3}$$

where Y_{it} is the quantity of food production measured in metric tons, Aid_{it-1} is the quantity of food aid in metric tons (MT) at the period t-1, X_{it} represents a vector of exogenous variables affecting food production, τ_i is a country fixed effect, φ_t is the time fixed effect, and ε_{it} is the idiosyncratic error term. A full list of the explanatory variables is shown in the data section. In addition, we take the logarithm of the dependent variable and the endogenous variable food aid to make the distribution less skewed. Note that a value of one is added to food aid before taking the logarithm to preserve observations.

If the United States gave aid in response to production shocks in the developing countries, a concern surrounding reverse causality arises. Without any approach to address the endogeneity problem, the coefficient of the variable of interest is biased and inconsistent.

The identification strategy implemented is the instrumental variable method [3]. We follow the methods of Nunn and Qian (2014b) and Dreher and Langlotz (2015), who interacted time-variant excludable variables with the country's probability of receiving aid. In Nunn and Qian's paper, they examined how U.S. food aid affects conflict in recipient countries. Their identification strategy was to interact the U.S. wheat production in the preceding year with the country' s probability of receiving U.S. food aid. Following Nunn and Qian's method, Dreher and Langlotz (2015) studied the effect of foreign aid on economic

[3]The first stage of the 2SLS does not consider that the food aid variable is a corner solution. It is not a big problem here because consistency of 2SLS estimation does not dependent on the correct specification in the first-stage (Kelejian, 1971). Wooldridge (2002) also provided an approach to address the issue. He suggested to use fitted probabilities from a first-stage tobit model as an instrument for the endogenous variable. We followed Wooldridge's approach, and the results are the same as the conventional 2SLS results.

growth in a sample of 96 countries over the 1974-2009 period. They used donor government fractionalization to capture the variations in donor countries' aid shipments, relying on the assumption that legislature fragmentation increases government expenditures (Scartascini and Crain, 2002) and that larger government budgets increase aid budgets. They then introduced variations at the recipient-country level by interacting fractionalization with the share of years a country receives aid.

However, several concerns arise regarding the strategy used in the above two studies. Firstly, in both studies, the authors used the fraction of years over the study period that a country receives any U.S. food aid as one component of the instrument, which can be problematic. The food aid variable is endogenous, so it is not convincing to assume that the mean of the indicator variable of food aid over the sample period is exogenous. In addition, the mean value of the propensity of receiving food aid in the second stage captures only the variations in the outcome caused by either receiving or not food aid, instead of the absolute amount of food aid.

In this study, we use a three-way interaction term of U.S. wheat stocks, U.S. military assistance, and a measurement of a country' s alliance with the U.S. through its voting pattern in the U.N. in the preceding year to instrument for food aid. Compared to Nunn and Qian' s identification strategy, our instrument improves precision. Instead of using U.S. wheat production to capture the effects of surpluses on aid allocation, we use U.S. wheat stocks in the preceding year to introduce variations over years. The variable *U.S. wheat stocks* is directly related to the food aid flows, and thus it is unnecessary to assume that high wheat production would increase wheat stocks. We also replace the propensity of receiving food aid with the dollar amount of U.S. military aid to capture the intensity of the effect of food aid on the outcome. We include the U.N. voting score in the instrument to capture the variations in food aid receipts driven by political alignment considerations. The inclusion of the variable *alignment* increases the first-stage significance.

Each component of the instrument is relevant to food aid flows. Since one of the explicitly stated objectives of the U.S. food aid program is to dispose of surplus, we assume higher U.S. wheat stocks in the preceding year would lead to a higher amount of U.S. wheat

food aid in the following year. Due to the dominant proportion of U.S. wheat aid over the U.S. food aid program, we also expect a larger amount of U.S. cereal food aid as a result of an increased amount of wheat aid. We test these links by plotting bivariate relationships between wheat stocks, wheat aid, and cereal aid. Figure 10-1 captures the positive relationships between lagged U.S. wheat stocks and U.S. wheat aid delivered in year *t*. Figure 10-2 shows that U.S. wheat aid is positively related to U.S. cereal aid delivered in year *t*.

U.S. wheat stocks are positively related to cereal aid shipments, but including U.S. wheat stocks alone as the instrument is not feasible because all variations across countries can be captured by year fixed effects in the regression. To keep the variations caused by fluctuations in U.S. wheat stocks, we introduce the variations from the recipient-country side by interacting country-specific characteristics, which are the U.S. military aid and the country' s voting pattern in the U.N.

The variable *dollar amount of U.S. military aid* and the variable *voting score* are significant determinants of U.S. food aid. U.S. military aid is positively related to cereal aid flows, shown in Figure 11-1. The bivariate coefficient is 0.22 and significant at 1%. This indicates that food aid is often used together with military aid to achieve national security objectives. In addition, Barrett and Maxwell (2006) argued that countries that have experienced heavy intervention by U.S. armies are more likely to receive food aid as a way to ease agitation. Furthermore, Figure 11-2 demonstrates that the alliance with the U.S. through voting in the U.N. is also positively related to food aid. The United States tends to give food aid to its allied countries. Raschky and Schwindt (2009) also instrumented foreign aid with the voting patterns in the United Nations General Assembly. They argued that it is common for donor countries, including the U.S., to reward their political allies.

These variables are not only relevant but are also excludable, meaning that each component of the instrument affects production only through its influence on food aid. Lagged U.S. wheat production is a donor-country-based variable, and thus is considered as exogenous since it is not related to recipient countries' characteristics and therefore could not directly affect domestic food production except through the food aid channel. A country' s voting

pattern in the U.N. is also excludable. One may be concerned about the possibility that U.S. may deliver more non-food aid economic assistance to countries that are politically closer to the United States. We thus include the U.S. non-food aid economic assistance in the regression to control for the influences of the variable *alignment* on production via its impact on other types of economic assistance. As for the third variable, dollar amounts of U.S. military aid measured in logarithm, it also affects domestic production only through its influence on U.S. food aid conditional on the explanatory variables. Other than the food aid channel, it is also possible that the effects of military aid on production come through conflict. Thus, we include a dummy variable of conflict in the regression to capture the differential effects of U.S. military aid on production through the outbreaks of conflict.

In addition to controlling for the indicator of conflict, we provide additional evidence to support the excludability of the variable *U.S. military aid*. U.S. military aid has been deployed to support U.S. military-strategic interests over the long run, instead of in response to outbreaks of conflict. For example, Greece and Turkey received large amounts of military aid during the 1960s because of the Truman Doctrine, although no conflict in these two countries outbroke during the same period. The U.S. gave millions of dollars in military aid to countries threatened by Soviet communism and other anticommunist regimes throughout the world to develop alliances against the Soviet Union. To some extent, U.S. military aid is driven by American foreign policy and is not directly related to outbreaks of conflict. We check the bivariate relationships between the existence of conflict and an indicator of receiving any amount of U.S. military aid. The insignificant coefficient with a large p-value (0.14) indicates that U.S. military aid is not significantly related to conflict. This means that we do not have sufficient evidence to conclude that military aid is in response to outbreaks of conflict. U.S. military aid is arguably excludable conditional on explanatory variables.

We discussed the validity of our instrument in the previous paragraphs. The mathematical derivations of the IV method are shown below [4].

Let the vector $X_{it} = (X_{1it}, X_{2it} ... X_{kit})$ be regressors where X_{1it} is endogenous variable

[4]The notations and derivations are from Wooldridge (2010).

and X_{kit} is a vector of all excluded regressors. In our case, the variable food aid and food production are endogenous given the presence of reverse causality. By definition, we know that $E[X_{1it}u] \neq 0$, and thus using the ordinary least squares (OLS) method could generate biased and inconsistent estimators. One option is to use the IV fixed effect estimators, which can be obtained by a two-stage least squares (2SLS) regression. Compared to the OLS estimators, the 2SLS estimators are consistent if the instrument is (1) relevant to endogenous variable, and (2) uncorrelated with whatever is not observed that is a determinant of y_i (Wooldridge, 2010). There are two steps involved in getting the 2SLS estimator as what the name infers. In the first stage, we strip from X_{1it} that part of the variation that is uncorrelated to u, and we can get:

$$\hat{X} = P_z X \tag{5.4}$$

where $P_z = Z(Z'Z)^{-1}Z'$ and the vector $Z_{it} = (Z_{1it}, X_{2it}...X_{kit})$. In the second stage, we use $\hat{X}$ instead of X in our regression $y = \hat{X}\beta_{IV} + v$. Thus, the IV estimate is

$$\hat{\beta_{IV}} = (X'Z(Z'Z)^{-1}Z'X)^{-1}X'Z(Z'Z)^{-1}Z'y = (Z'X)^{-1}Z'y \tag{5.5}$$

The two-stage least squares (2SLS) approach is a common way to estimate IV estimator, and the 2SLS estimator is also called the instrumental variables (IV) estimator or the generalized instrumental variable estimator (GIVE). In this paper, we consider a more general framework, which is an instrumental variable estimator implemented using the Generalized Method of Moments (GMM). The 2SLS estimator is one type of GMM estimator when the model is under conditional homoskedasticity. With robust standard errors, 2SLS estimator is consistent but not efficient. Thus, GMM estimator is more efficient in the presence of heteroskedasticity in the regression (Wooldridge, 2010).

Let's revise the classical 2SLS approach from the GMM perspective. The principle of the GMM approach is to choose the estimators of unknown parameters that force the sample moment conditions to hold. The assumption that the instruments Z are orthogonal to error terms can be shown as $E(Z_i u_i) = 0$. The M instruments give us a set of M moments $(M \geqslant K)$. Since

each of the M moment equations maps one-to-one to a sample moment, we have the following equation for sample moments

$$\bar{g}(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} g_i(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} Z_i\prime(y_i - X_i\hat{\beta}) = \frac{1}{n}Z\prime\hat{u} \tag{5.6}$$

The goal is to get an estimator for β that makes $\bar{g}(\hat{\beta}) = 0$.

If the equation is under exact identification, which means we have M moment conditions for the M unknown parameters, we are able to get exact solutions that make $\bar{g}(\hat{\beta}) = 0$. If the equation is the overidentified case, where the moment conditions (M) is greater than the number of parameters (K), it is impossible to use all moments to solve the problem, and thus the objective of GMM is to choose β so $\bar{g}(\hat{\beta})$ is close to zero. The GMM approach constructs an $M \times M$ weighting matrix W to capture the possible weights assigned to each moment in order to minimize $\bar{g}(\hat{\beta})$. Thus, the objective function is shown as

$$F(\hat{\beta}) = n\bar{g}(\hat{\beta})'W\bar{g}(\hat{\beta}) \tag{5.7}$$

Taking the first-order derivative to minimize the objective function, we can get the GMM estimator below:

$$\hat{\beta_{GMM}} = (X'ZWZ'X)^{-1}X'ZWZ'y \tag{5.8}$$

There are many GMM estimators depending on the form of the weighting matrix. Hansen (1982) invented the optimal weighting matrix, which represented W as $W = S^{-1}$ to produce the most efficient estimator. The matrix S is shown as

$$S = \frac{1}{n}E[Z'uu'Z] = \frac{1}{n}E[Z'\Omega Z] \tag{5.9}$$

Knowing the consistent estimator S allows us to get the efficient GMM estimator, which is

$$\hat{\beta_{EGMM}} = (X'ZS^{-1}Z'X)^{-1}X'ZS^{-1}Z'y \tag{5.10}$$

In order to estimate S, it is necessary to know the form of Ω, which is the variance-covariance matrix of the error. If the errors are independent and identically distributed (iid), $S = {\sigma_u}^2 I_N$ and the optimal weighting matrix is the identity matrix. In this case, the IV-GMM estimator is the same as the 2SLS estimator. If there is heteroskedasticity or errors exhibit cluster correlation,

$$\hat{S} = \sum_{j=1}^{M} \hat{u_j}' \hat{u_j} \tag{5.11}$$

where

$$\hat{u_j} = (y_j - x_j \hat{\beta}) X' Z (Z'Z)^{-1} z_j \tag{5.12}$$

The IV-GMM estimates using this estimation of S will be robust to heteroskedasticity and intra-cluster correlation. In our study, we expect the existence of heteroskedasticity because it is likely that changes in the variance correspond to changes in explanatory variables. To exclude the noise of heteroskedasticity, we will use the IV-GMM estimator.

CHAPTER 6

DATA DESCRIPTION

This study uses a panel dataset consisting of 118 countries over the period 1961-2006. The pattern of the data is an unbalanced panel from 1961-2006, and this is unbalanced due to the dissolution and independence of several countries during this time period. The countries of interest are developing countries with income levels varying from upper middle income, lower middle income to low income levels, spreading out over six regions. These regions are the following: East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa. These categorizations are based on the World Bank's regional classification. A full list of countries shows in Table 3. [1]

The food aid datasets come from the USDA, and production data are from the Food and Agricultural Organization's statistical database (FAO-STAT). Other data on economic conditions and recipient countries' characteristics are gathered from various sources, which will be described in details in the first subsection. All of these variables are merged together to form our master dataset. The commodity of interest is the total cereal grains in metric tons. Given that the FAOSTAT and USDA have different rules for standardizing and aggregating data, we re-structure FAOSTAT production data to follow the hierarchy in the food aid dataset so as to make these two datasets comparable. A detailed procedure of aggregation and re-classification will be provided in the second subsection. In addition, we will discuss the approach we used to select countries, followed by the method to address inconsistency problem arising from different definitions for a country regarding whether the winning part of a divided country represents the nation after unification or whether a brand new country with a different identifier from former parts should be used. The ultimate goal of our clearing process is to make variables comparable and consistent based on pre-determined "standards". Finally,

[1] Figure 12 shows a global map that highlighted these 118 countries. The areas of countries are shaded in proportional to the quantities of local cereal production, and the size of dots represents the relative quantitative values in food aid receipts.

some data limitations will be discussed.

6.1 Variable Definitions

The food aid variable measures the total quantity of in-kind food aid delivered from the U.S. to recipient countries. As long as food commodities are procured and dispatched from the United States, these commodities can be categorized as in-kind food aid. This food aid variable is an aggregation of Title I program aid, Title II emergency aid, and Title III project aid. The unit of the variable is measured in metric tons (MT). Food aid data are from two sources. The 1955-1973 food aid data are manually digitized from the USDA report "Agricultural Exports under Public Law 480" (1974). The 1972-2006 data come from the USDA-Foreign Agricultural Service (FAS). We have overlapping information for 1972 and 1973 that come from different sources. The data in these two files are quite consistent, and we keep food aid data in 1972 and 1973 from the USDA's FAS. Given all efforts, food aid data for 1990 and 1991 are unavailable.

Production data come from the FAOSTAT, and are supplied by governments through national publications, FAO questionnaires and international organizations and agencies. Data contain production information on primary products over the calendar year. If the harvest of crops takes place between years, production of a given commodity is allocated to the calendar year in which most of harvest occurs. As regards production data for cereals, the yield number is related to crops harvested for dry grain but not to crops harvested for hay, or grazing purposes. (2012)

In addition to food aid and production data, we control for many other variables, including precipitation, disasters, conflicts, trade openness, GDP, population, institutional democracy, arable land (% of total land of a country), and U.S. economic aid (net of U.S. food aid). The following paragraph illustrates the definition, data source and the possible impact on food production for each controlled variable.

Precipitation data come from Climatic Research Unit at the Tyndall Centre (Mitchell et al., 2004), and data measure the annual precipitation in millimeters from 1960-2000. The

remaining six years of data are computed using ArcMap from the dataset known as "Terrestrial Air Temperature and Precipitation, Version 1.10" (Matsuura and Willmott, 2007), which includes the monthly mean precipitation for grid-cells globally. Country boundary shapefiles are used to obtain country-level precipitation. Since the geographic or altitude differentiations may contribute to different volumes of rain, we standardize the volumes of precipitation by subtracting the mean value from annual rainfall in order to obtain the deviation from the mean. Given the summary statistics in Table 4, the mean value of the rainfall deviations is -0.07mm.

In addition, data on disasters come from the EM-DAT International Disaster Database from the Centre for Research on the Epidemiology of Disasters (CRED) in Belgium (Guha-Sapir, Below, and Hoyois, 2015). The variable is discrete with an increment of one along with a outbreak of a disaster in a given year. In particular, six types of natural disasters are taken into account. These are geo-physical, meteorological, hydrological, climatological, biological, and extraterrestrial (very rare) disasters. In order for a disaster to be counted, the disaster must have "at least ten casualties, affect at least one hundred people, and require a declaration of a state-level emergency or call for international assistance" (Guha-Sapir, Below, and Hoyois, 2015). The mean value of this variable is 1.43. The largest number ever recorded was 37 in 2006 in China. Compared to other countries, the historical numbers of disasters for China were relatively large, being around 9 in the 1980s and 17 in the 1990s and 2000s. The South Asian region also has the highest mean number of disasters (3.8), followed by the East Asian and Pacific region with the mean value of 2.9, as shown in Table 5. Middle Eastern and North African countries have the lowest mean value for disasters, which is 0.76.

Climate conditions and natural disasters all have significant influences on agricultural production. We can expect a negative impact to be produced by extremely large or small precipitation on food production as well as a negative effect of disasters on production. More specifically, Lobell, Schlenker, and Costa (2011) provided empirical evidence regarding the impacts of climate variability on food production. Their study stated that abnormal changes in climate from 1980 to 2008 reduced global production of wheat by 5.5% relative to a

counterfactual without climate change. Given the evidence of the impact of climate conditions on food production, especially cereals whose growth is highly reliant on weather, it is important to control for precipitation. In addition, disasters can heavily affect agricultural production. A FAO's study (2015) shows that the agriculture sector retains 22 percent of the aggregated financial losses created by disasters. Within the agriculture sector, 42 percent of harm is burdened by the crop sub-sector. Thus, cereal production can be severely affected by natural disasters, particularly by floods, storms and droughts.

The conflict data come from the UCDP-PRIO Armed Conflict Dataset (version 4-2014a) (Therese and Wallensteen, 2015), where the definition of a conflict refers to the use of armed force that results in at least 25 battle deaths annually. A conflict can be an intrastate, interstate, or extra-systemic conflict. The conflict variable in this paper is a dummy variable, and is used to capture the outbreak of any type of conflict in a country. The mean value of this variable is 0.25. South Asian countries have the largest mean value of the outbreaks of conflict (0.52) while European and Central Asian countries have the smallest mean value (0.09).

We expect conflict to produce a negative impact on food production, since conflicts can lead to the deterioration of farmers' incentives to produce food by disturbing the output food market as well as input food market. Rebels in conflict regions are likely to destroy or seize food stocks. The isolation of the combat zones from surrounding areas can prevent local farmers from getting access to input resources and transporting products to local markets. In addition, young labor force in the families may join the troops voluntarily or involuntarily. Such a labor supply shortage can lead to a reduction in food production. Another way in which conflicts lead to food shortages is through the use of landmines. Landmines contains toxic waste, which can pollute agricultural terrains and disrupt soil quality. This concern prevents farmers from relying on these fields for sustenance (Messer and Cohen, 2007).

The data on GDP, trade openness, and population are from the Penn World Tables (version 6.3). GDP is measured in terms of per capita and are measured in terms of constant 2005 U.S. dollars. Openness equals exports plus imports over GDP, which indicates the intensity of international trade. The variable *openness* is measured at 2005 U.S. dollars. The

population variable is measured in thousands. The summary statistics for regions (Table 5) show that countries in Europe and Central Asia have the largest mean of the variable GDP per capita. By contrast, Sub-Saharan African countries are relatively poor. Middle Eastern and North African countries are intensively involved in international trade due to the largest mean value being the trade variable of openness. South Asian as well as East Asian and Pacific countries have the highest population on average during the 1961-2006 period.

Our expectation is that GDP, trade openness, and population are all positively correlated with food production. A country with a high gross domestic production indicator can be expected to exhibit better economic performance in the manufacturing, industrial and agricultural sectors. In addition, a high GDP country generally has advanced technology, which can stimulate growth in agricultural growth. Similarly, a nation with a large population can generally be expected to have affluent labor supply, which can benefit the labor-intensive agricultural sector. As regards the influence of trade, research has shown that countries which have embraced globalization and increasing openness to the international exchange of goods and services are more likely to introduce new ideas and technologies, which can result in a high growth rate compared to countries that are less open to the rest of the world (Andersen and Babula, 2008). To some extent, international trade can serve as a buffer that can mitigate the impact of shocks on national production. Countries can export more products when food supply is excessive while importing more from abroad when food shortages prevail, in order to stabilize domestic food levels.

Institutional democracy data come from the Polity Data Archive, which was initially published by Gleditsch in the Department of Government at the University of Essex Colchester in 2003. The data we used are the fourth version, which was modified in 2008, and contain longitudinal data on the characteristics of nations' political regime. The democracy variable takes on integer values, ranging from 0 (the least democratic) to 10 (the highest level of democracy). The measurement of democracy involves three perspectives: the competitiveness of government official elections, the completeness of legislation, and the easiness of the shift of political power. The average value of this variable is 2.72. Sub-Saharan

African, and Middle Eastern and North African countries have low democracy indicators on average. Political democracy in a nation is believed to have a positive influence on agricultural production. This is because the political environment in a democratic country is more friendly to well-being policies, and thus creates favorable conditions for achieving food security (Sen, 1981; Sen and Dreze, 1989).

Arable land data are from the FAOSTAT, which measure the percentage of arable land divided by total land areas. The mean value is 0.16, as shown in Table 4. Larger amounts of farming land can be expected to increase production, subject to the production technology and weather shocks.

U.S. economic assistance and U.S. military aid data come from the U.S. Overseas Loans and Grants (Greenbook), and were prepared by USAID Economic Analysis and Data Services on March 28, 2014. The dataset contains the amount of assistance (current dollars) provided by a given program to a country in a particular year. Using the purchasing power parity provided in the Penn State Tables, the value is converted into constant U.S. dollars using a base year of 2005. The mean values of U.S. economic assistance and U.S. military aid are 767000 and 562000 thousand dollars, respectively. East Asian and Pacific countries as well as Middle Eastern and North African countries received more U.S. military aid on average. Countries in Middle East and North Africa as well as in South Asia received more non-food aid economic assistance.

The economic aid variable includes all types of economic aid provided by the United States, except for food aid so as to avoid double accounting. The positive relationship between economic aid and food production is not hard to depict. Many aid programs, such as the Food for Education programs, seek to improve literacy and reduce hunger by encouraging school attendance and promoting food production.

Producer price data come from three sources. The FAO website provides data for producer farmgate prices measured in terms of the U.S. dollar during the period of 1991 to 2014. The FAO Archive contains producer price data prior to 1991, with measurements given in terms of the local currency. We convert the units from the local currencies to U.S. dollars

using the exchange rate provided in the PWT. However, the exchange rates for some countries in particular years were extremely small due to measurement error, and thus generated large producer prices. In order to ensure that data on producer prices are reliable, we replace producer prices with missing values if producer prices exceed 10000 U.S. dollars. Finally, we use producer price data from Anderson and Valenzuela (2008) as a supplementary data source. His dataset entailed 97 relatively large countries, and had limited coverage of countries compared to the FAO dataset. Anderson's dataset only supplements 133 observations that the FAO data are missing.

6.2 Re-mapping FAO Data

The challenge is to make food aid and FAO production data comparable. The problem is that FAO production data contain different categories of commodities with various processed levels from commodities in food aid datasets. In general, FAO production data are more disaggregated than food aid data. To make these datasets comparable, a re-classification of FAO commodities is necessary by mapping the FAO commodity codes into the codes used in food aid data. The principle is that each FAO product code is assigned just one aid code at the lowest possible level of aggregation. Using this method allows FAO production data to have the same structure as food aid data.

Table 6 shows the structure of food aid data with one food aid code for each commodity. More specifically, the structure of food aid data is hierarchical and has four aggregation levels. The top-level commodity groups are the most aggregated. They contain eight categories of commodities, which are animal and animal products, grains and preparations, fruits and preparations, vegetables and preparations, oilseed products, tobacco, cotton excluding linters, and other. Within each top-level commodity group, commodities are further categorized into three levels based on processed levels.

Similarly, FAO trade data and FAO food balance sheets are all restructured to maintain the same hierarchy as food aid data. After the transformation, different FAO datasets all contain

the same products in each category. Thus, the top-level aggregated commodity items provide us with consistent and comparable estimates of data for further analysis.

6.3 Country Selection

The complete number of countries and territories in the data set is 236, including countries that are of interest in this study and those that are not. This paragraph below summarizes the criteria we used to select countries. We exclude high-income and small population countries based on the data for 1954, as well as countries with no production data and food aid data throughout the whole sample period. We use countries' characteristics (population and income levels) prior to the implementation of U.S. food aid programs when characteristics are exogenous to food aid programs. Once food aid programs commenced, food aid might affect countries' characteristics, resulting in bias if selection was based on data from later years.

First, we drop high-income countries. The World Bank provides country classifications by income based on estimates of GNI per capita. Four income groups are low-income, lower-income, upper-income, and high-income groups. The thresholds for inclusion in income groups were established in 1987 with an explicit benchmark of $6000 per capita for high-income countries (World Bank, 2016). To extrapolate the thresholds in 1954, we use the SDR deflator, which is also the current methodology used by the World Bank, to adjust for inflation. Since the historical SDR deflator data starts in 1960, it is not possible to obtain the income group thresholds for 1954. We use the threshold for the high-income group in 1960 ($869) as an approximation for the threshold in 1954. Based on this criterion, we drop 41 high-income countries [2].

We then use the population data for 1954 from the Penn World Table to drop countries with extremely small populations. The threshold of population for small countries used in

[2]American Samoa, Aruba, Australia, Austria, Bahamas, Bahrain, Belgium, Bermuda, Brunei, Canada, Denmark, Faroe, Finland, France, Germany, Greenland, Guam, Hong Kong, Iceland, Ireland , Isle of Man, Israel, Italy, Japan, Kuwait, Luxembourg, Netherlands, New Zealand, Norway, Qatar, Saudia Arabia, Singapore, Spain, Sweden, Switzerland, Taiwan, United Arab Emirates, United Kingdom, United States, Us Virgin, West Germany.

this paper originated with Salvatore, Svetlicic, and Damijan (2016), who defines extremely small nations as those having populations of less than 1 million. Given that countries that have extremely small populations are of little economic significance, we excluded 47 countries [3] that had less than 1 million people in 1954. In addition, there were 5 countries [4] for which population data for 1954 were not available but which should be considered to be extremely small countries. We excluded those 5 countries as well.

Finally, 25 countries [5] have no food aid and food production data during the sample period. These countries are excluded from the sample. FAO production data for the former Soviet Union countries began in 1992, whereas the food aid data for those countries began in 1991. We drop these observations in 1991. In the results section, we show that the analysis results do not change if we kept data for the former Soviet Union countries in 1991. We are left with 118 countries in the sample.

6.4 Country Definition

Several countries dissolved and reunited over the course of history. These changes pose difficulties for our analysis because different datasets use different methods to record changes that have occurred in the country. In order to ensure that data from various sources has the same country-year structure, we use the criteria below to standardize the list of countries.

The United States delivered food aid to some regimes even before they became independent and world-recognized countries. We consider the initial year of these countries to be those in which they first received U.S. food aid in order to preserve more food aid data. Otherwise, we consider the initial year of a country to be when the U.S. recognized the

[3] Antigua Barbuda, Barbados, Belize, Bhutan, Botswana, Cape Verde, Comoros, Congo, Costa Rica, Cyprus, Djibouti, Dominica, Equatorial Guinea, Fiji, Gabon, Gambia, Grenada, Guinea Bissau, Guyana, Jordan, Kiribati, Lesotho, Liberia, Macau, Maldives, Malta, Marshall, Mauritius, Micronesia, Mongolia, Namibia, Oman, Palau, Panama, Samoa, Sao Tomme Principe, Seychelles, Solomon, St. Kitts Nevis, St. Lucia, St. Vincent Grenadines, Suriname, Swaziland, Timor Leste, Tonga, Trinidad, Tobago, Vanuatu.

[4] French Guiana, Montserrat, New Caledonia, Pacific Trust, Reunion Is.

[5] Andorra, British Virgin, Cayman Islands, Cocos, Cook Islands, East Germany, French Polynesia, Liechtenstein, Martinique, Monaco, Nauru, Niue, Norfolk, North Vietnam, San Marino, St. Helena, St. Pierre Miquelon, Tokelau, Tuvalu, Wallis Futuna, Guadeloupe, Netherlands Antilles, Palestine, South Yemen, Western Sahara.

independence of the country. In addition, we decide to adopt the approach used in the Polity IV dataset to recode countries as new countries after major changes, e.g., a new code was generated for Yemen after unification (Marshall, Jaggers, and Gurr, 2010). An alternative method was developed by Gleditsch and Ward (1997), who considered the "winning" country to be a continuation. For example, after Yemen's reunification, the South Yemen code ceases to be used to designate that country and the North Yemen code continues. In this paper, we choose to use the Policy IV approach to standardize different approaches used in the UCDP-PRIO Armed Conflict Dataset and the Policy Data Achieve.

Furthermore, together with the names of recipient countries, ISO3, COWid, and FAOid are also identifiers we used to merge country-specific characteristics, policy-related data, and FAO data into the recipient country-year master files. ISO alpha-3 codes are three-letter country codes published by the International Organization for Standardization (ISO). COWid stands for the Correlates of War country ID. FAOid is the country identifier used by the FAOSTAT. These country identifiers are extremely useful for identification purposes during the process of merging when the country name is missing.

6.5 Limitations

The limitations of data derive from the intrinsic nature of data itself. Several variables have missing values due to a comprehensive coverage of countries over the course of a long period of time. These variables include deviation of precipitation, openness score, real GDP per capita, democracy score and voting score. As regards the variable precipitation, several countries have missing values for consecutive years before 2000. For other variables, missingness seems to spread out across countries, and many countries have missing values only for one or a few years. No clear patterns in the missingness can be found, and the number of missing observations is relatively small compared to the total number of observations. Due to difficulties in finding the missing data from different sources, we decide to ignore observations with missing values.

In addition, the other intrinsic drawback of the data is that they only contain the total aggregated food aid data, and thus the composition of Title I and Title II aid is unknown. The lack of this piece of information restricted us from exploring the differences in the impacts of various titles of food aid on production, although studying the determinants of aid allocation allows us to make inferences about the relative proportion of each title of food aid.

Finally, the discrepancy in when the record of a country starts introduces inconsistency. Our approach, as discussed above, is to recognize a country when the U.S. recognizes its independence or when the country first received U.S. food aid if receiving food aid occurred before the independence of the country. However, the FAO organizes production data according to when the U.N. recognizes a country. This results in several countries being in the FAO production data but not the U.S. food aid dataset because the U.N. recognizes the country while the U.S. does not. These countries are relatively small in terms of country size and population, and many of them are dropped from the selection of "eligible" countries. We address this issue by using the FAO's country-year records and assuming that the U.S. shipped no food aid during the gap period where the U.N. recognizes the country but the U.S. has not yet done so. This may introduce measurement error, and modifications are made to a limited number of countries.

CHAPTER 7

RESULTS

7.1 Determinants of U.S. Food Aid

Baseline Estimates

Table 7 summarizes the findings of food aid determinants for all recipient countries from 1961 to 2006. Column 1 shows the OLS estimates. Column 2 displays the random effects tobit estimates using the maximum-likelihood method. We control for unobserved heterogeneity among countries in the regression. The marginal effects at the mean are reported in Column 3. Finally, the estimates using the Mundlak-Chamberlain approach and the marginal effects at the mean are shown in Columns 4 and 5, respectively.

The results are similar under all specifications. Food aid shipments are responsive to donor political interests as well as recipient countries' needs. The coefficient of the one-year lagged U.S. cereal production is positive and is significant at the 10% level. This implies that the U.S. gives more cereal aid in a particular year if last year's cereal production was large. However, U.S. cereal production does not have a contemporaneous effect on food aid allocation. This finding supports the surpluses-disposal objective of food aid in the U.S., which involves shipping surpluses that were excessive stocks left from the previous year. In addition, countries with similar voting patterns in the U.N. General Assembly as the U.S. are more likely to receive food aid. This indicates that the U.S. uses food aid as an instrument to reward its political allies. The coefficient of the variable *military aid* is significantly positive. Two possible explanations can explain this positive estimate: the U.S. may use food aid to mitigate the tension in areas receiving a large amount of military aid, or it may use soldiers to deliver food aid, counting the expenditures incurred in the process of transportation as military aid expenses.

With regard to recipient countries, the results in Table 7 show that countries that have a

large population, lower GDP per capita, and conflicts and disasters are likely to receive more cereal aid. The signs of these variables are within our expectations that the U.S. ships more aid to populous and poor countries as well as those countries suffering from disasters and conflicts. The results confirm that U.S. food aid allocation is also on the basis of recipient needs to some extent. Furthermore, the coefficients of local cereal production at year *t* and at year *t-1* are significantly negative. This implies that U.S. cereal aid allocation is partially driven by cereal production shortfalls in recipient countries. However, the insignificance of the variable *democracy score* indicates that the U.S. does not seem to deliver more food aid to democratic governments. Food aid allocation is irrelevant to policy performance of the recipient countries.

Food Aid Allocation Before and After 1990

We separate the sample into pre-1990 and post-1990 groups to examine if determinants of food aid allocation changed. We use the year 1990 as the divider because the U.S. explicitly stated the promotion of food security as one of its objectives in 1990. Table 8 displays the marginal estimates at the mean using the Mundlak-Chamberlain approach. Column 1 displays the estimates using the whole sample period for comparison. Before 1990, the coefficient of the one-year lagged U.S. cereal production is significantly positive at the 1% confidence level, as shown in Column 2. However, the U.S. cereal production level does not seem to influence food aid allocation after 1990, as shown in Column 3. This change is not surprising because U.S. cereal stocks drained after 1990, and thus cereal aid was not driven by surplus disposal anymore. In regards to the cereal production level in recipient countries, prior to 1990, the U.S. seemed to respond to production shortfalls by delivering more food aid in the following year, but this was not the case after 1990. Although the correlation between aid flows and production shortfalls in recipient countries after 1990 is insignificant, the variable *disaster* is statistically significant in the post-1990 period. This indicates that the U.S. tends to give food aid to countries that experience disasters in the same year. The change in the variable *disaster* from an insignificant to significant factor is consistent with a shift in the objective of the U.S. food aid program to respond to humanitarian needs on the basis of the US's political interests.

In spite of some changes in the determinants of food aid before and after 1990, some similarities exist in the patterns of food aid allocation. The variable *democracy* is insignificant in all time periods. The variable *conflict* is also statistically insignificant in the pre- and post-1990 periods, although the coefficient of this variable is significantly negative at the 10% significance level using the full sample.

Food Aid Allocation by Regions

We divide countries by regions and run the regression for each region. Table 9 reports the marginal estimates at the mean using the baseline specification. The variables U.S. cereal production at year *t* and *t-1* are significant for Sub-Saharan African countries. This indicates that food aid to Sub-Saharan African countries is partially driven by U.S. cereal production surpluses. As for the variable *cereal production in recipient countries*, a negative coefficient can be found except for countries in East Asia and the Pacific as well as Middle East and North Africa. Compared to the production shortfalls in these two regions, other factors, such as disasters in the East Asian and Pacific region and the amount of military aid in the Middle Eastern and North African regions, are more prominent and attract more food aid distributions. In addition, the European and Central Asian as well as South Asian countries with high U.S. voting alignment seem to receive more food aid. Surprisingly, the coefficient of the variable *GDP per capita* is positive for Sub-Saharan African countries, while this variable is negatively related to food aid flows for countries in other regions.

Patterns in the Allocation of Other Food Aid Commodities

All the analysis above focused on the patterns of U.S. cereal food aid allocation. In addition to cereal food aid, the U.S. ships animal products (mainly dry milk powder) and oilseed products (mainly soybean oilseeds) as food aid. Table 10 shows the results for the determinants of animal and oilseed products from 1960 to 2006. The coefficient of the variable *local production of animal products at t-1* is positive, whereas the coefficient of the

variable *oilseed production in recipient countries at t-1* is negative. This implies that animal product food aid seems to be less relevant to shortfalls in production of animal-related commodities. One similarity in the distribution among these three types of food aid is that U.S. production of these commodities is positively related to food aid flows in the subsequent year. This result indicates that animal product and oilseed food aid are partially driven by the surpluses-disposal objective as well.

This finding is in line with the U.S. domestic farm policy. In 1930, the U.S. implemented the Dairy Price Support Program to purchase excessive dairy products, including butter, cheddar cheese, and dry milk powder, on the open market to stabilize prices (Sumner and Balagtas, 2002). The CCC was in charge of purchasing, and the excessive products were stored in the government reserves. In addition, the U.S. government provided direct subsidies for U.S. exporters of dairy products. Subsidized exports, together with food aid donations, were used to dispose of surpluses of dairy commodities obtained under the price support program. Similar to dairy products, the U.S. government implemented a price support program and provided subsidies for oilseed producers and exporters. Oilseed food aid, thus, was shipped in order to dispose of excessive stocks.

Discussion

Before moving to the results of impacts on production, we summarize the patterns of U.S. food aid allocation and compare our findings to previous studies. Similar to many studies, we find that U.S. food aid allocation is driven by donor's interests and recipient countries' needs. From the donor's perspective, the U.S. is likely to give food aid to its political allies and countries with military-strategic importance for it. In contrast, Neumayer (2005) concluded that military-strategic interests did not seem to be a factor that affected U.S. food aid allocation in the 1990s. The differentiation may come from the difference in time period. In our study, military interests do not seem to be significant when we restrict the sample to observations in the 1990s. We also conclude that food aid is positively related to U.S. production with a one-year lag, which is consistent with findings in Nunn and Qian's paper (2014). They found that

U.S. cereal food aid is partially driven by U.S. cereal production surpluses. Although grains are the main food aid commodities, the U.S. delivers other food aid commodities in addition to grains. Extending the types of food aid commodities, we also test if animal products and oilseeds are used as food aid to dispose of surpluses. Our findings confirm the hypothesis that surplus disposal is one of determinants for cereal, animal product, and oilseed food aid.

From the recipient country's perspective, the U.S. is likely to deliver more food aid to populous, poor, disaster-prone, and conflict-affected countries. Furthermore, U.S. food aid responds to contemporaneous production shortfalls as well as to production shocks with a one-year lag in recipient countries. This finding indicates a possibility of reverse causality between food aid flows and domestic production, and thus justifies the use of the instrumental variable method to isolate one effect from the other in the following section. The insignificant determinant in our study is democracy, which is considered a significant factor of foreign aid in many papers (Berthélemy and Tichit, 2004; Alesina and Dollar, 2000). Countries that have a higher level of democratic progress usually attract more foreign aid but not food aid from the U.S.

Comparing observations before and after 1990, we find that domestic surpluses were an influential factor prior to 1990 while humanitarian concerns were significant after 1990. Ball and Johnson (1996) studied the objectives behind the different titles of food aid and concluded that the determinants of Title I and Title II food aid matched their stated objectives, that is to say that Title I food aid is primarily driven by surpluses-disposal and political interests, whereas Title II food aid is targeted to fulfill the humanitarian needs of recipient countries. To analyze our findings one step further, the changes in the objectives indicate a shift in the relative proportion of Title I and Title II food aid over the total amount, from Title I being dominant before 1990 to Title II after 1990. For policy-makers and researchers, it is important to know which types of food aid dominate during the time period of interest because different titles of food aid may have different impacts on the outcomes.

Finally, we conclude that the patterns of U.S. food aid allocation across regions are different. Sub-Saharan African countries are of particular interest because many SSA nations

rely heavily on food aid. We find that the U.S. is likely to deliver more food aid to relatively rich SSA countries as well as to SSA countries that experience production shocks. Some previous studies Nunn and Qian (2014a); Young and Abbott (2008) confirm that food aid given to SSA countries is partially driven by production shocks, but none of these studies explicitly discussed the income levels of the recipient countries. The fact that the U.S. ships food aid to relatively rich instead of poor SSA countries poses a question of how efficient the targeting is. It remains unclear as to whether the U.S. intentionally shipped food aid to rich SSA countries or food aid was ended up with rich SSA countries due to the poor targeting, and thus more research is needed.

7.2 The Effects of Food Aid on Production

Three-way Interaction Instrument

The first column of Table 11 shows the OLS estimates. We include a set of covariates as well as country and year fixed effects to account for omitted variable bias. The OLS estimate of the variable *log (U.S. cereal aid)* is -0.01 and is significant at the 5% significance level. The interpretation of the negative coefficient is ambiguous due to the presence of simultaneity bias in the regression. This negative coefficient might indicate that U.S. cereal aid reduces cereal production in recipient countries or that the U.S. gives more aid to countries that experience production shocks. In order to separate the two effects from each other, we adopt the instrumental variable method.

Columns 2-4 in Table 11 summarize the findings of the two-stage least square (2SLS) estimates. We use a three-way interaction among the quantities of U.S. wheat stocks, the dollar amount of U.S. military aid, and the alignment with the U.S. in the preceding year as the instrument for the quantities of U.S. cereal aid. All of the regressions include baseline controls. The first stage Keibergen-Paap F-statistic is 17. Since this number exceeds 10, which is the commonly agreed-upon benchmark for a strong instrument, we are less concerned about weak instrument bias. The point estimate of the instrument in the first stage is 0.00099, and this is

statistically significant at the 0.01 level of confidence. Consider the case of a country which received the sample mean amount of military aid of $7.2 measured in logarithm and had the mean U.N. voting score of 0.24 one year prior to receiving food aid. A 1000 metric tons increase in the U.S. cereal stocks could have led to a 17 MT ($7.2 \times 0.24 \times 0.0099 \times 1000$) increase in the amount of cereal aid received in the following year.

In the reduced form, the coefficient of the instrument is -0.00061. This is significant at the 0.001 confidence level (Column 3 of Table 11). This indicates that for the same country discussed in the above paragraph that received the mean value of military aid and had the mean voting score, a 1000 MT increase in the U.S. cereal stocks two years previously would decrease cereal production by 0.61% this year.

Dividing the coefficient of the instrument in the reduced form by the coefficient in the first stage gives the two stage least square estimate, as shown in the fourth column of Table 11. The results support the hypothesis that cereal food aid negatively affects cereal production. The 2SLS estimate of the variable *log (U.S. cereal aid)* is -0.062 and is significant at the 1% level. This suggests that if the U.S. were to double cereal aid, cereal production in recipient countries would decrease by 6.2%. Disaggregating cereal aid into three main types of grains, which are wheat, rice, and feed grains, Columns 5-7 of Table 11 show that the effects of cereal aid on production are primarily driven by wheat and feed grains.

One limitation of measuring quantities of cereal aid in terms of metric tons is that there is no differentiation among different types of grains. In reality, one metric ton of wheat is worth more than one metric ton of rice from the nutritional perspective. This is the case because wheat provides more calories than rice given the same quantities in metric tons. In order to examine the effects of cereal aid on production using caloric measurements, we use the FAO convertor to transform the unit of aid from metric tons to calories.

Column 8 in Table 11 shows the estimates using caloric measurements, and the regression includes the above instrument and baseline controls. The magnitudes and significance levels for the exogenous independent variables are similar to those in the regression with the variables being measured in metric tons. However, the 2SLS estimate of

the variable of interest, meaning cereal aid in terms of calories during the previous year, is -0.032. This estimate is less than that (-0.062) under the specification of using metric tons as the unit. The coefficient remains statistically significant at the 1% confidence level. This result is consistent with the results measured in metric tons and implies that U.S. cereal food aid can lead to a reduction in cereal production during the following year in recipient countries.

Two-way Interaction Instrument

We use the interaction term between the U.S. wheat stocks and the amount of the U.S. military aid measured in logarithm in the previous year as the instrument for the following year's cereal aid. The estimates appear in Table 12. The findings are similar to the estimates shown in Table 11, except for smaller point estimates of the instrument in the first stage and the reduced form. The coefficient of the instrument in the first stage is statistically significant and equals 0.0026, as shown in the first column of Table 12. It is consistent with the hypothesis that U.S. food aid allocation is positively correlated with U.S. military aid. This means that countries that received a large amount of military aid have a propensity to receive more U.S. food aid than countries that received a small amount of military aid, in years when wheat stocks were sufficient relative to years when wheat stocks were in shortage. In addition, the first stage Keibergen-Paap F-statistic is 11, which exceeds 10 but is less than the F-statistic in the first stage when using the three-way interaction instrument.

The third column of Table 12 shows that the 2SLS estimate under this specification is also similar to the 2SLS estimate reported in Table 11. The coefficient is equal to -0.056, which is significant at the 5% confidence level. The negative sign of the estimate supports hypothesis that there are disincentive effects of food aid on food production, which is consistent with the results in Table 11. Compared to the three-way interaction instrument, using the interacted instrument allows for the preservation of 98 more observations because these observations have missing values in the variable *alignment*. After restricting the number of observations down to 3531, column 5 of Table 12 shows that there is no significant difference between the results in the restricted sample (Column 5) and unrestricted sample (Column 3).

In conjunction with the results in Table 11, the 2SLS estimates in Table 12 provide evidence of the negative effects of cereal aid on cereal production. We address the issue of simultaneity bias in the model using the instrument for the endogenous variable food aid. However, given a higher first stage Keibergen-Paap F-statistic in the regression with the three-way interaction instrument, we decide to use this instrument along with the baseline controls for the following regressions. Note that we also use the interacted instrument for all tests and the results are robust regardless of which instrument is used.

Lagged Dependent Variable

In the previous discussion, we did not control for the lagged dependent variable in the regression. In the real world, however, food production is persistent in a manner such that last year's production is correlated with this year's food production. This is usually the case because many factors, such as droughts and the soil quality, may last more than one year and affect production persistently. Year-end stocks of grains may have an impact on food market in the following year. In addition, the persistence of food production is likely due to the local crop rotation system, which involves changes in the planting of certain crops over the years.

To incorporate this fact into the model, we add the one-year lagged cereal production on the right-hand side of the regression. Columns 1-3 of Table 13 shows the estimates using the instrumental variable method with country and year fixed effects. The third column of Table 13 shows that the 2SLS estimate of the variable *cereal aid* is still significantly negative, but the magnitude of the coefficient is smaller than that without controlling for the lagged dependent variable. This is reasonable because the coefficient of the instrument in the reduced form decreases, although the estimate in the first stage is similar to the estimate in the regression without lagged production. By considering one-year lagged production, doubling U.S. cereal food aid may lead to a 2.3% decrease in cereal production for the following year. The estimate of the lagged dependent variable is 0.55, which is statistically significant at the 1% level. The positive sign of this estimate confirms the hypothesis that production for the last year positively affects the current year's production.

However, controlling for the lagged dependent variable in a fixed effect model introduces the Nickell Bias in the reduced form, which arises because the demeaning process or the first-difference process creates correlations between regressors and the error term. To address the Nickell Bias, we use the Arellano-Bond method. The results are shown in Column 4 of Table 13. More specifically, we use the second lag of the dependent variable as the instrument for the one-year lagged dependent variable. We do this because the AR (2) statistic is insignificant, which indicates that there is no autocorrelation between the error term in *t* and in *t-2*. The coefficient of the lagged dependent variable decreases to 0.14, although the estimate is statistically significant. The estimate of the variable food aid is -0.015, which is slightly smaller than the estimate reported in column 3 in terms of magnitude. Column 5 of Table 13 shows the estimates of variables as measured in calories. Cereal aid is still negatively related to cereal production in the following year, and other estimates are similar to estimates in the regression with metric tons as the unit of measure in Column 4, although the magnitude of cereal aid is reduced to -0.0069. The results are consistent with the findings in Column 8 of Table 11 such that the extent of the disincentive effect of food aid is smaller when the variables are measured in calories instead of metric tons in the regressions with and without controlling for the lagged dependent variable. This indicates that recipient countries tend to reduce production for relatively low-calorie crops while receiving high-calorie cereal aid from the U.S.

In sum, the effects of cereal aid on production remain significantly negative under all specifications, although the magnitudes of the coefficient differ depending on whether or not we control for the lagged dependent variable. In comparison with the model without the lagged dependent variable, controlling for one-year lagged cereal production generates a smaller coefficient in terms of the magnitude in the fixed effects model. The magnitude of this coefficient is similar to that in the regression with adjustment for the Nickell Bias. One possible explanation for this might be that lagged production is an important explanatory variable for current year's production. When we control for the lagged dependent variable in the regression, we are less likely to have omitted variable bias. We thus consider the

Arellano-Bond model with variables measured in terms of metric tons as the optimum specification so far. The coefficient of -0.015 means that, when the U.S. increases the amount of food aid by a mean value of 70832 MT, the average reduction in production is around 173952 MT (0.015 $\times$ 11596800).

Validity of The Instrument

We now provide supporting evidence regarding the validity of the instrument. Restrictively speaking, a valid instrument must pass the relevance and exogeneity tests. The significant coefficient of the instrument in the first stage allows us to state the relevance between the instrument and endogenous variable. As regards the exogeneity requirement, the method section includes the justification for exogeneity. In addition, we conduct additional tests to verify the validity of the instrument.

The variable food aid is endogenous because domestic production is one determinant of food aid allocation, which is shown in Table 7. Here, we also conduct the Hausman test to test the endogeneity of the variable food aid. A key assumption of the Hausman test is that the 2SLS estimate is unbiased. By testing whether the difference between the 2SLS estimate and OLS estimate approximates zero, the Hausman test provides the inference regarding the endogeneity of the variable food aid. The null hypothesis of the Hausman test is exogeneity. A very small p-value (0.0003) suggests that cereal food aid is highly endogenous with regard to cereal production, after including all of the control factors. Again, the result of Hausman test justifies the use of the instrumental variable method only if the 2SLS estimate is unbiased.

One concern regarding the validity of the instrument arises due to the ambiguity in the time lag between sufficient stocks and food aid shipments. When using the current instrument, we assume that the U.S. would ship more food aid during the current year if stocks in the last year were sufficient. This assumption is fairly strong. It is possible that if the U.S. ships food aid at the end of the current year, then this year's wheat stocks will have contemporaneous effects on food aid shipments. In order to test the sensitivity of the choice of the lags with respect to the results, Columns 1-3 of Table 14 show the first-stage estimates when the variable wheat

stocks is lagged by one, two, and three years. The other two components of the instrument still have two-year lags. The results show that the instrument is significant in the first-stage under all three circumstances. Although the assumption that food aid is positively related to last year's wheat stocks is restrictive, relaxing this assumption does not change the significance of the instrument.

In addition, Column 4 of Table 14 provides the first-stage estimates when we replace U.S. wheat stocks with feed grain stocks. The new instrument is also significant in the first stage. The significance is not surprising because feed grain aid constitutes the second largest type of grains delivered as food aid, exceeded only by wheat. Together with military aid and voting similarity scores, variations in feed grain stocks can capture some variations in cereal food aid as well. Given that the first stage F statistic of the new instrument is smaller than the F statistic of the equation that uses wheat stocks as one component of the instrument, we prefer to use the instrument that includes wheat stocks.

Lastly, we lag the instrument by two and three years, and then use the instrument at periods *t* and *t+1* for the endogenous variable at *t-1*. The first-stage estimates in Column 5 and 6 are insignificant, meaning that the instrument could be used to predict future food aid instead of previous food aid. We also run the Arellano-Bond model that regressed cereal production at t on food aid at *t+1* and *t+2*. We use the instrument at *t+1* and *t+2* for the food aid variable at *t+1* and *t+2*, and the results are shown in Column 7 and 8. Again, we obtain insignificant coefficients of future food aid. The results support the validity of the instrument.

Heterogeneous Effects

We move on to study how the effects of food aid vary depending on a particular country's specific characteristics, and the results have implications for policy-makers. We divide the countries into groups based on time frame, regions, income levels, and the average frequency of receiving U.S. food aid, and then examine the heterogeneous effects of food aid on production. We use the Arellano-Bond method and the results are shown in Table 15. In all categories, production in the previous year was positively related to production during the current year.

In addition, for each group of characteristics, we generate a dummy variable, and interact the endogenous variable food aid with the dummy variable in order to represent the amount of aid received by this group. We interact the instrumental variable with the dummy variable to instrument for the new endogenous variable. An alternative method is to run the regression separately for each group. Using this approach may result in the loss of observations, although it allows for variations in the effects of other explanatory variables on the outcome across the groups. To maintain the sample size, we report the results of regressions that include dummy variables.[1]

The estimates in the first column of Table 15 reveal the effects of food aid on production prior to 1990. 1990 was a watershed year for the U.S. food aid program because the promotion of food security has been an explicit objective of food aid since 1990. Title II emergency food aid has been predominant since then, whereas the volume of Title I food aid decreased dramatically. The estimate of food aid before 1990 is -0.019 and is statistically significant. In conjunction with the point estimate of food aid (-0.015) during the whole sample period in Column 4 of Table 13, it can be inferred that the negative effect of food aid on production occurred during the years prior to 1990, when Title I food aid outweighed Title II food aid. The results make sense and can be supported by our identification strategy since the instruments, especially U.S. wheat stocks and U.S. military aid, were significantly related to food aid allocation before 1990. Others may argue that the relative proportions of Title I and Title II aid started to change during the mid-1980s. Column 2 shows the effects of food aid on production before 1985. The estimate in Column 2 is very similar to the estimate of the effects on production prior to 1990.

The estimates of Column 3 demonstrate the heterogeneous effects of food aid on production across regions. The regression also includes regional dummy variables. The results show that food aid exerts significantly negative effects on production in Sub-Saharan Africa. When we divide countries into three groups based on their income levels, estimates in Column 4 show that disincentive effects of aid exist for low-income countries. The results are

[1] We also use the second approach to study heterogeneous effects. Fortunately, heterogeneous effects are robust under both methods.

consistent with the findings for regions because most SSA countries are in the low-income category.

Finally, we check whether the effects of food aid on production differ between regular and irregular food recipient countries. We assign the value one to a country in a particular year if the country receives any amount of cereal aid. Based on the mean of the aid indicator during the entire time period, a country is categorized as a regular recipient country if the mean of the aid indicator is above the median (0.65). Otherwise, the country is an irregular recipient country. Column 5 shows that food aid has a disincentive effect on production in regular recipient countries. The point estimate is -0.017, meaning that a 100% increase in U.S. cereal food aid could lead to a 1.7% reduction in cereal production in regular recipient countries compared with irregular recipient countries. The results are in accordance with our expectations since regular recipient countries receive food aid more frequently, and are more likely to experience the effects of food aid if there are any. For irregular recipient countries, untimely and uncertain food aid flows may not be sufficient to persuade farmers to change production behavior.

Robustness and Other Tests

This section evaluates some other possible scenarios that might confound the interpretation of the results. We also exclude "outliers", and check the robustness of the results for different sets of countries.

The previous results lead to the conclusion that U.S. cereal aid had led to reductions in production in recipient countries. However, if the U.S. cereal aid crowds out cereal aid from other donors, the negative effects on cereal production could be a result of the reduction in non-U.S. cereal aid. The presence of the crowd-out has different implications for policy makers than the situation without crowd out, and this may undermine the external validity of this study. In order to determine whether the provision of U.S. cereal aid reduces the amount of cereal aid from non-U.S. donors, we regress cereal aid from non-U.S. donors on U.S. cereal aid. The first column of Table 16 displays the 2SLS estimates. The significantly positive coefficient of U.S.

cereal aid suggests that we could not find sufficient evidence to support the crowding-out effects of U.S. cereal aid on cereal aid from other donors. On the contrary, the point estimate of 0.4 indicates that other donors are likely to increase cereal aid donations when the U.S. provides more aid.

In addition, it is possible that cereal food aid may drive farmers away from cereal production due to distortions in the market. Instead of producing cereals, farmers may produce additional grain substitutes. This test aims to provide more policy implications. Columns 2-7 of Table 16 display the effects of U.S. cereal aid on production of animal products, fruits, vegetables, oilseeds, tobacco, and cotton respectively. The model used is the Arellano-Bond estimation. The estimate of cereal aid is insignificant, whereas the lagged dependent variable is significant in all regressions. We can not find any evidence that farmers change cereal production to other types of production in response to the provision of cereal aid. We also expect to observe insignificant results due to the small amount of cereal aid compared to the production level. Even if some farmers were to increase their production of other commodities, such an increase would be too negligible to exert any significant effects on production. [2]

Table 17 reports the Arellano-Bond estimates, while excluding Russia and South Vietnam, respectively. Russia and South Vietnam can be categorized as outliers. Russia received huge amounts of cereal aid right after the dissolution of the Soviet Union. As regards South Vietnam, that country received large amounts of U.S. military aid but was not allied with the U.S. The estimates show that excluding these two countries generates very similar results as using the model that includes the full observations (Column 4 of Table 13). These tests ensure that our results are not sensitive to outliers.

Column 3, 4 and 5 of Table 17 show the results of the first-stage, 2SLS, and Arellano-Bond regressions that use the interaction term of the variable *wheat stocks* and alignment at *t-1* as the instrument for the endogenous variable food aid in the following year. We conducted this test to provide evidence for the validity of the instrument to those who are still concerned about

[2]We also use the instrumental variable method in the fixed effect model with and without controlling for the one-year lagged dependent variable. All of the regressions generated insignificant results.

the excludability of the variable *dollar amount of U.S. military aid in logarithm*. It may be argued that military aid is likely to affect domestic production through its influence on conflict in addition to the food aid channel although we control for the one-year lagged conflict in the regression and provide an argument of irrelevance between military aid and outbreaks of conflict. Here we show that the disincentive effect of food aid on production exists regardless of whether we include military aid in the instrument or not.

Excluding the military aid component in the instrument, the first stage estimate in Column 3 is still significant at the 1% level although the first stage Keibergen-Paap F-Statistic is reduced to 7.4. This new instrument is weak, and the new 2SLS estimate is expected to be larger than the estimate using a strong instrument. Column 4 shows that the new 2SLS estimate is -0.74, which is larger in terms of the magnitude than the estimate using the three-way interaction instrument. This 2SLS estimate is significant at the 10% level. This indicates that U.S. military aid has a large power in explaining variations in U.S. food aid shipments, but the disincentive effects on production do not mainly come from the effects of military aid. Thus, the channels through which military aid affects domestic production are not that crucial.

Mechanism

We now study the mechanism of the disincentive effect of food aid on production, that is to explore through which channels that food aid could decrease production. The first hypothesis is the price effect. As discussed in the theoretical framework, an inflow of food aid, regardless of its Title, is very likely to reduce domestic price, thereby decreasing production. We test this hypothesis by regressing the log form of the dollar amount of wheat producer prices on the variable cereal aid in the instrumental variable model with the time and country fixed effects. The first column of Table 18 shows the insignificant impact of cereal aid on wheat price. [3] The number of observations in the regression is only 1,903, which accounts for roughly half of the

[3]We do not find the significant effects of food aid on price when we restrict the recipient countries to wheat-growing countries, either.

total number of observations. The loss of observations is due to the limited availability of price data. When we examine the impact of cereal aid on wheat price for low income countries before 1990, Column 2 of Table 18 shows a negative coefficient of -0.017 and significant at the 10% level. This indicates that food aid might reduce wheat producer price for low-income countries prior to 1990. However, the limited number of observations requires additional caution when interpreting the results. In addition, we examine other groups in which the disincentive effects on production are observable, and the estimates still show insignificant results.

Several reasons contribute to the insignificance of the price effect. Firstly, producer price data are of poor quality. The FAO collects farm-gate prices (producer prices) by sending out annual questionnaires to local farmers. The isolation of some developing countries from the outside world, either due to poor road infrastructure or intra-conflict, may prevent researchers to collect data. In addition, countries' response rate is low, especially for African countries. The FAO's report shows that the average response rate for Africa during 2002-2007 was 29% (FAO, 2007). In addition to the incompleteness of data, developing countries sometimes provide prices in non-standard quantities or provide no information on conversion factors to the metric system (FAO, 2007). This compromises the quality of producer price data to a large extent. Thus, the inability to find any significant effects on price using our data does not necessarily imply the nonexistence of changes in price. Furthermore, governments in some developing countries implemented price stabilization policies in response to the arrival of food aid in the local market. Bezuneh, Deaton, and Zuhair (2003) found that stabilization of prices alleviated price fluctuations caused by food aid, and reduced the adverse impacts of food aid on the local market in Tunisia. In other places, the government established a series of policies to support local farmers, such as establishing a price floor for crops or distributing subsidies to farmers. With the implementation of price stabilization or price support policies, local producer prices cannot accurately reflect the market conditions in recipient countries, and thus it would be problematic to use FAO producer prices to study the price effect.

In addition to the price channel, food aid may decrease food production through its impact on government actions. The availability of food aid may give policy makers excuses to

postpone reforms in agriculture. Food aid simply disguises recipient countries' own shortcomings in food provision. Instead of investing in the agricultural sector, governments invest in other areas, such as urbanization. In Africa, the rate of urbanization increased from 15% in 1960 to 40% in 2010, making urbanization the main policy narrative (Habitat, 2010). In Nigeria, Rakodi (1997) estimated that 80% of investments spent on urban-area development instead of agricultural development. If food aid resulted in a hesitation in essential agricultural reforms or a shift in the investment priority away from agriculture, production would be expected to decrease.

Discussion

We find that U.S. cereal food aid in the preceding year decreases local cereal production in the following year using the instrumental variable method. The effects are primarily from wheat and feed grain food aid. This finding confirms the disincentive effects of food aid on production, which have been extensively discussed in theoretical papers but little evidence has been shown in empirical studies. This negative relationship still holds when we control for the one-year lagged dependent variable in the Arellano-Bond model, which is considered as the optimal specification that addresses the Nickell bias.

As regards the magnitude of the effects, the coefficient of -0.015 in the AB model indicates that if the U.S. doubled food aid shipments, production in the recipient countries would decrease by 1.5% on average. This magnitude is similar to the effect found in the previous studies (Gelan, 2007; Seevers, 1968). Seevers (1968) used supply and demand elasticities along with plausible values for other variables in India to estimate the magnitude of the disincentive effect. He found that an about 100% increase in food aid would cause 7.9% drop in local food prices, and thus lead to a 2% decrease in domestic production. However, Seevers' study is old and covered the period of 1956-57 and 1961-62. Gelan (2007) studied the percentage increase in production in Ethiopia with a removal of food aid. Using the computable general equilibrium model, Gelan concluded with a 2.2% increase in production in absence of in-kind food aid. Compared to the magnitude in Gelan's paper, the coefficient in

our study is smaller. This is expected because we study the average effect in developing countries while Gelan only studied Ethiopia, which relies heavily on food aid. In spite of this small difference in the magnitude, our study supports the disincentive effects of food aid, and this finding is not subject to a particular method.

In addition, we find that the magnitude of the disincentive effects is reduced when we change the measurement unit of production and food aid to calories from metric tons. A decrease in the magnitude of the coefficient indicates that recipient countries, which receive aid in the form of high-calorie grains from the U.S., tend to reduce the production of grains that contain fewer calories relative to wheat, which is the primary type of U.S. cereal aid. From this perspective, U.S. cereal aid discourages cereal production to a lesser extent.

The results also show that the disincentive effects are significant for Sub-Saharan African and low-income countries. In contrast to our findings, Abdulai, Barrett, and Hoddinott (2005) showed that food aid did not depress food production in rural Sub-Saharan African countries. Abdulai (2000) used the WFP food aid data in a vector autoregression model and studied the dynamic relationships between production and food aid during 1970-2000. The differentiated findings may be a result of different data, methods, and time periods between Abdulai's paper and our study.

The contradicting findings also highlight the different effects of various types of food aid on the outcome. The WFP food aid data used in Abdulai's paper was mainly comprised of U.S. Title II emergency food aid while this paper used aggregated food aid data. When we also focus on the time period when Title II food aid dominated in our data, the results show that the effect of food aid on production is insignificant, which is consistent with Abdulai's findings. This confirms the importance of knowing which types of food aid are prominent in the studied period because different titles of food aid could have different impacts on the outcomes.

As to whether or not food aid depresses production also depends on the frequency of a country receiving food aid. We find that the disincentive effects of food aid on production are significant for regular recipient countries but insignificant for irregular recipient countries. The results are in line with previous literature (Tadesse and Shively, 2009) that found that the

lack of certainty in the amount and delivery time of food aid makes any changes in production unwise. Lowder (2004) also considered the uncertainty of food aid shipments as one of the explanations for insignificant impacts of aid on production found in his paper.

Finally, we exclude other channels that may confound our interpretation of the negative coefficient of food aid. First, we do not find evidence that U.S. cereal food aid crowds out cereal aid from other donors, and thus we eliminate the probability that the negative effects on cereal production are caused by the reduction in non-U.S. cereal aid. Furthermore, no evidence can be found that farmers are driven away from cereal production to animal or vegetable production due to the distortion in the grain market. When we examine if food aid reduces production through its impact on price, we fail to get conclusive results because of poor quality of food producer price data. Although food aid reduced wheat producer prices for low-income countries prior to 1990, the limited number of observations requires extra caution when interpreting the results.

CHAPTER 8

CONCLUSION

U.S. food aid is an important tool to alleviate hunger and promote food security. However, many researchers have expressed concerns over the disincentive effects of food aid on production. Many studies empirically tested whether food aid depresses local agricultural production using market-level data, but their results vary widely depending on the characteristics of the country as well as the time period in their studies. In spite of the rigorous design of the models, these micro-level studies lack external validity, and the results are strictly restricted to a given setting, including geographic location, cultural context, and demographic characteristics. Undoubtedly this casts a shadow on their power to address policy questions. Our study, instead, uses country-level data and provides policy makers causal evidence of the average effects of food aid on production in recipient countries.

This paper studies the impacts of food aid on production using a dataset with coverage of 118 developing countries from 1961–2006. Before discussing the effects on production, we also explore the patterns in food aid distribution to acquire a better insight about the driving forces of the U.S. food aid programs. Food aid shipments are responsive to donor countries' political interests as well as recipient countries' needs. The U.S. is likely to give food aid to its political allies and countries with military-strategic importance to the United States, especially when the U.S. cereal stocks are sufficient. With regard to recipient countries, populous and poor countries as well as those countries suffering from disasters and conflicts are likely to receive more U.S. food aid. Importantly, the U.S. responds to production shortfalls in recipient countries. This finding indicates a possibility of reverse causality between food aid flows and domestic production, and thus justifies the use of the instrumental variable method to isolate one effect from the other in the study of the impacts on production. Specifically, we use a three-way interaction term of U.S. wheat stocks, U.S. military assistance, and a measurement of a country's alliance with the U.S. through its voting pattern in the U.N. to instrument for food

aid receipts in the following year. The results show that U.S. cereal food aid depresses cereal production in recipient countries. This negative relationship still holds when we include the one-year lagged dependent variable and run the regression using the Arellano-Bond approach. Food aid may decrease production through its influence on price or through the changes in government actions. Due to the limitations of data, we do not have sufficient evidence to support our hypotheses. Further micro-level research is necessary to identify channels through which food aid affects production.

In general, our results may deliver a pessimistic attitude towards the U.S. food aid program, but the heterogeneous effects of food aid convey more policy implications. The disincentive effects of food aid on production are particularly significant for Sub-Saharan African countries, low-income countries, and regular recipients of U.S. food aid. This provides policy makers important information on groups of countries that are more likely to experience the disincentive effects, and food aid allocation to these groups should be thoroughly evaluated in order to minimize the adverse impacts.

Knowing the existence of disincentive effects in SSA countries has significant policy implications. Sub-Saharan African countries experienced declined per capita food production over the past fifty years in spite of receiving a large amount of foreign assistance. In this paper, we provide empirical evidence that food aid depresses food production in Sub-Saharan African countries. We are not saying food aid recipients are the only contributors that should be blamed for the low production level in the SSA; nevertheless, many societal and historical reasons are attributable to the slow agricultural development. For those who are struggling with sufficient food provisions, such as many SSA countries, this negative impact on production caused by food aid is likely to result in a higher dependence on food aid, which may lead to far-reaching consequences in the long run. The findings of this paper could let policy-makers reconsider the accountability of food aid on poverty in SSA. Yet, before any policy decision is made, we still need to understand the key causes of poverty and evaluate the available assistance delivered to SSA.

Another interesting finding that is significant for policy-makers is the change in the

effects of food aid on production along with the change in the composition of the food aid programs. Before 1990, Title I food aid dominated and the disincentive effect was significant. In contrast, the disincentive effect disappeared after 1990 when Title II emergency food aid dominated. Title I food aid, on average, has an adverse impact on local production while Title II food aid does not. This result corresponds to the theoretical framework that program food aid may cause an excessive supply in the market, which is likely to result in a reduction in price. Although Title I food aid is no longer used, the nonemergency assistance under Title II is similar to Title I in that NGOs sell food aid in the market to use the proceeds for projects. The findings of this paper suggest that policy-makers as well as NGOs be aware of different effects of food aid under different titles and, if it is possible, mainly use food aid for humanitarian needs.

Finally, we discuss potential directions for future studies. This study uses macro-level data. It would be interesting to focus on top destinations of food aid shipments and examine the effects at the household level as well. To get a valid policy inference, researchers should analyze the evidence from different perspectives, either at the micro- or macro-levels, and then combine the results from empirical studies with reasoned intuition. Admittedly, the effect of food aid on production is only one aspect of the impacts of food aid. To gain a comprehensive understanding of the efficiency and effectiveness of the U.S. food aid program, findings on other perspectives, such as the impacts on food security, economic growth, and commercial trade are all necessary. Lastly, it would be important to study if the impacts of in-kind food aid on food production are different from the impacts of cash transfer assistance. The Administration and Congress recognize the need for food aid reforms to replace in-kind food aid with cash transfers and local purchases. Due to the disincentive effects of in-kind food aid, in-kind food aid may not be the best tool to assist development; however, this does not necessarily mean that cash transfers and local purchases do not have any adverse impacts. Therefore, thorough comparison studies between in-kind food aid and other types of assistance should be conducted to gather more evidence to either support or oppose the reforms.

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FIGURES AND TABLES

Figure 1: Total Quantities of U.S. Food Aid (1961-2006)

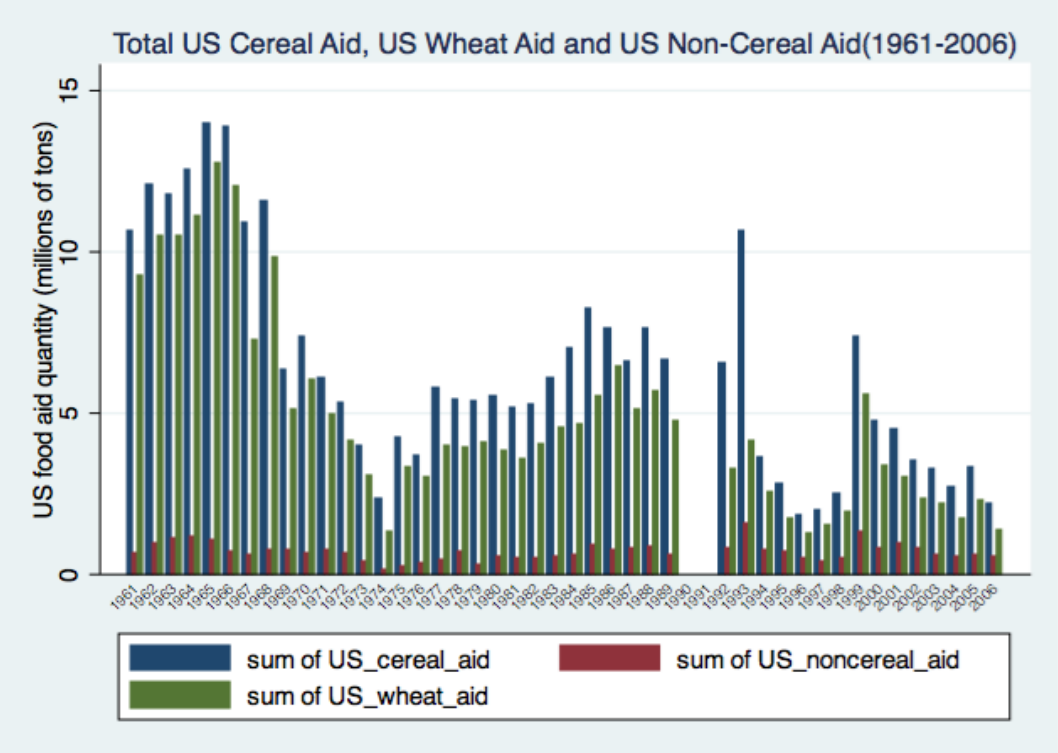


Figure 2: U.S. Food Aid Commodities

Fig 2-1 Commodity Groups of U.S. Food Aid (1961-2006)

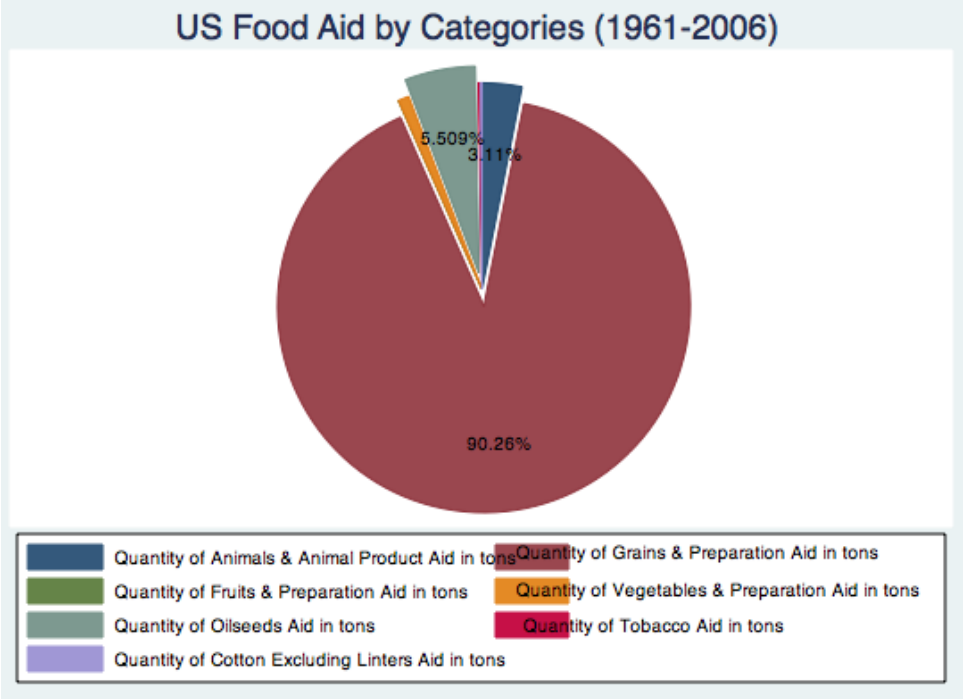


Fig 2-2 Compositions of U.S. Cereal Aid (1961-2006)

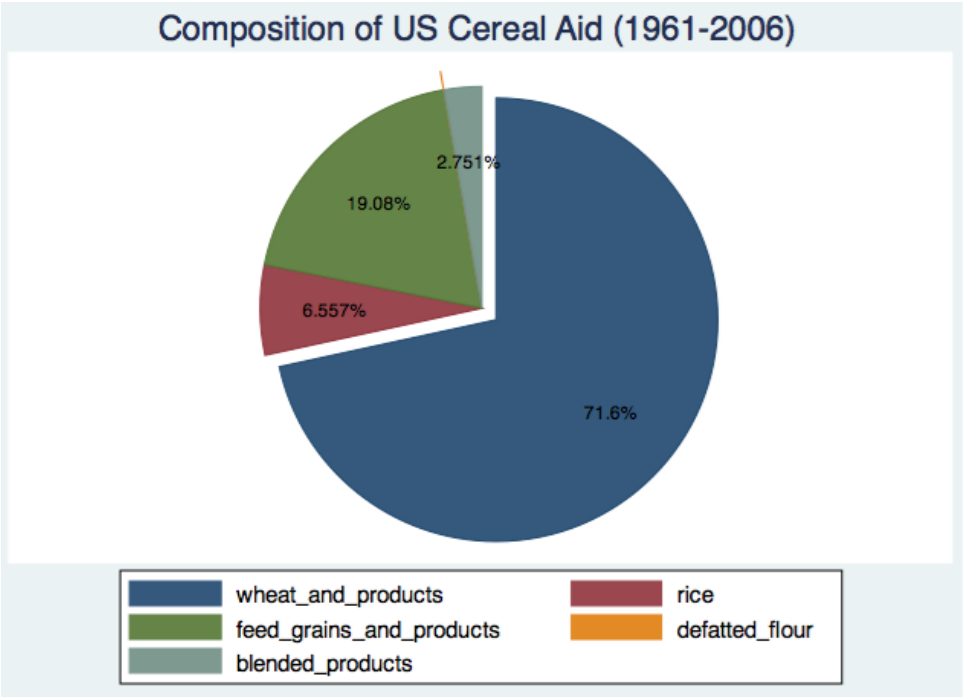


Figure 3: Commodity Groups of U.S. Food Aid by Decades(1961-2006)

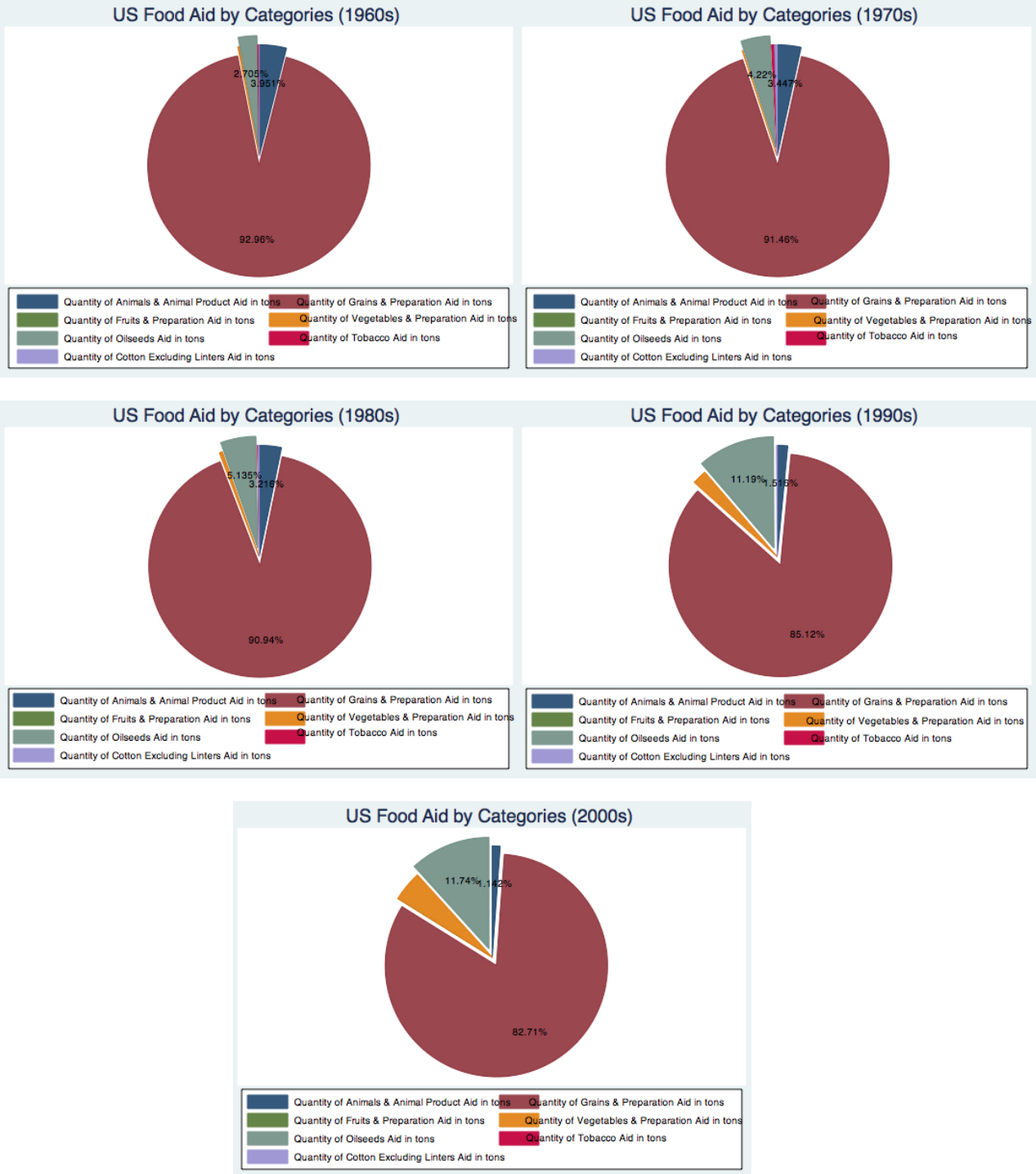


Figure 4: Compositions of U.S. Cereal Aid by Decades(1961-2006)

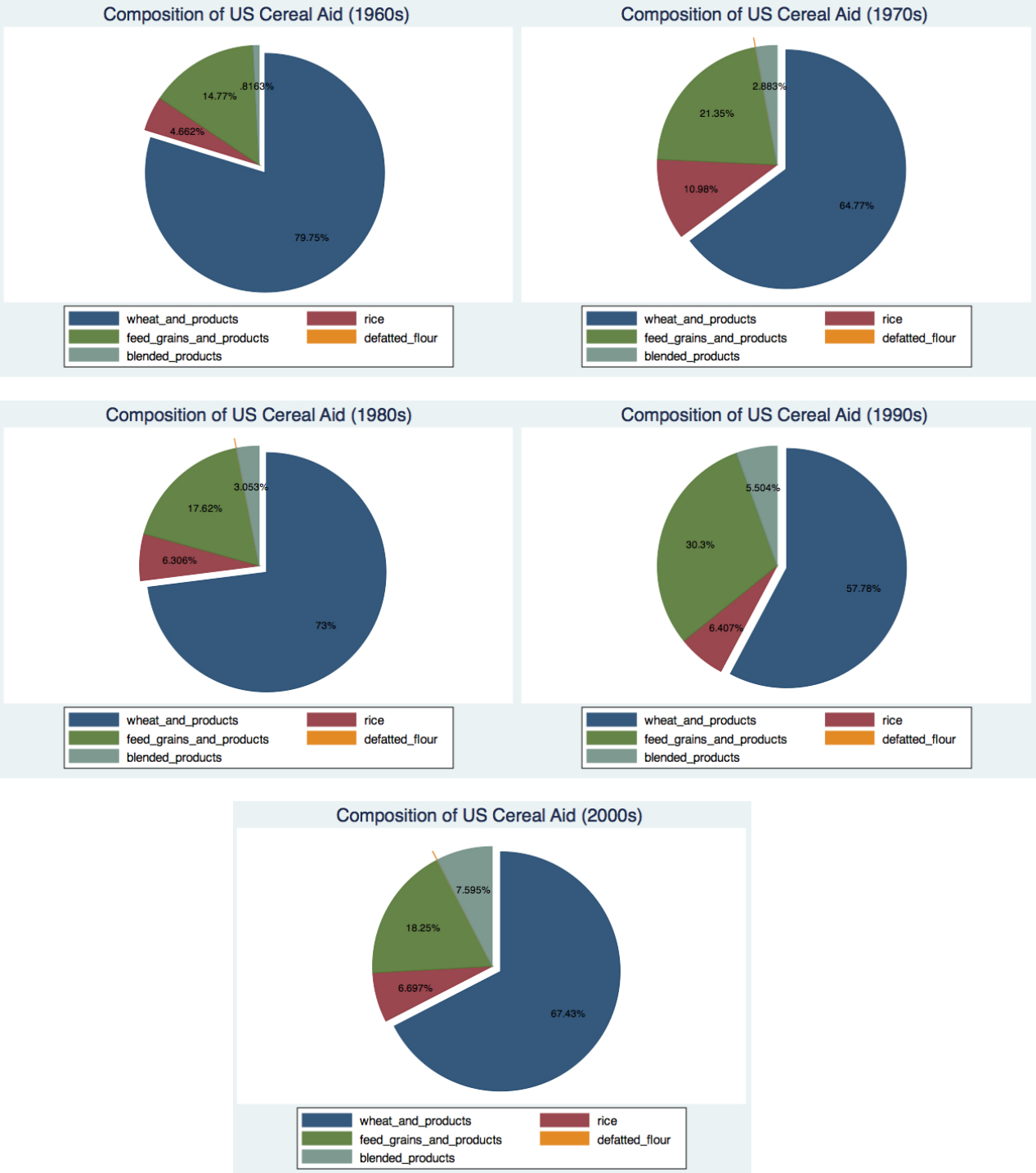


Figure 5: U.S. Food Aid Shipments by Regions (1961-2006)

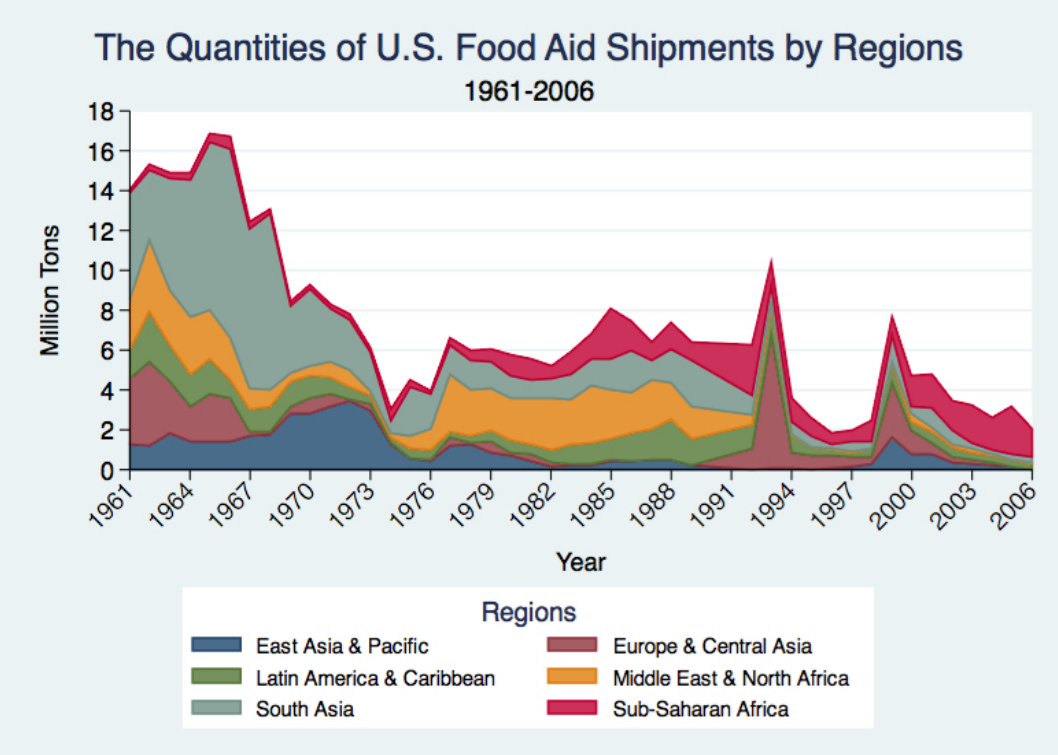


Figure 6: Top Recipient Countries

Fig 6-1: Top Recipient Countries prior 1990

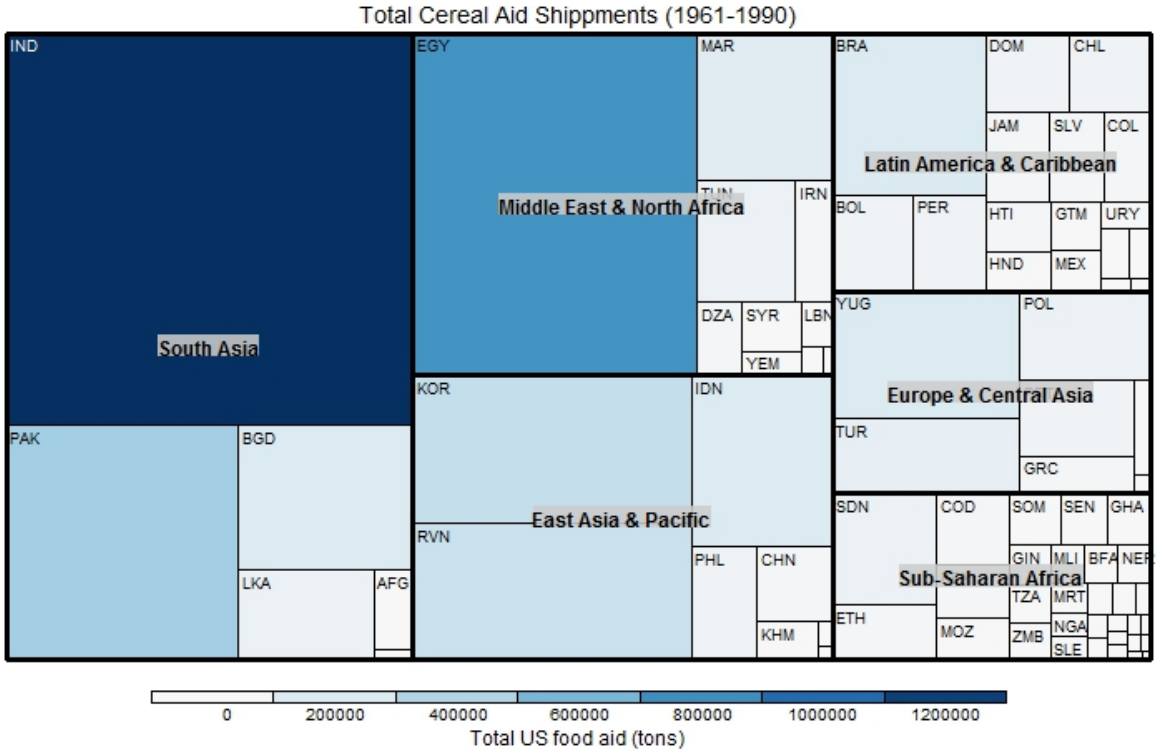


Fig 6-2: Top Recipient Countries after 1990

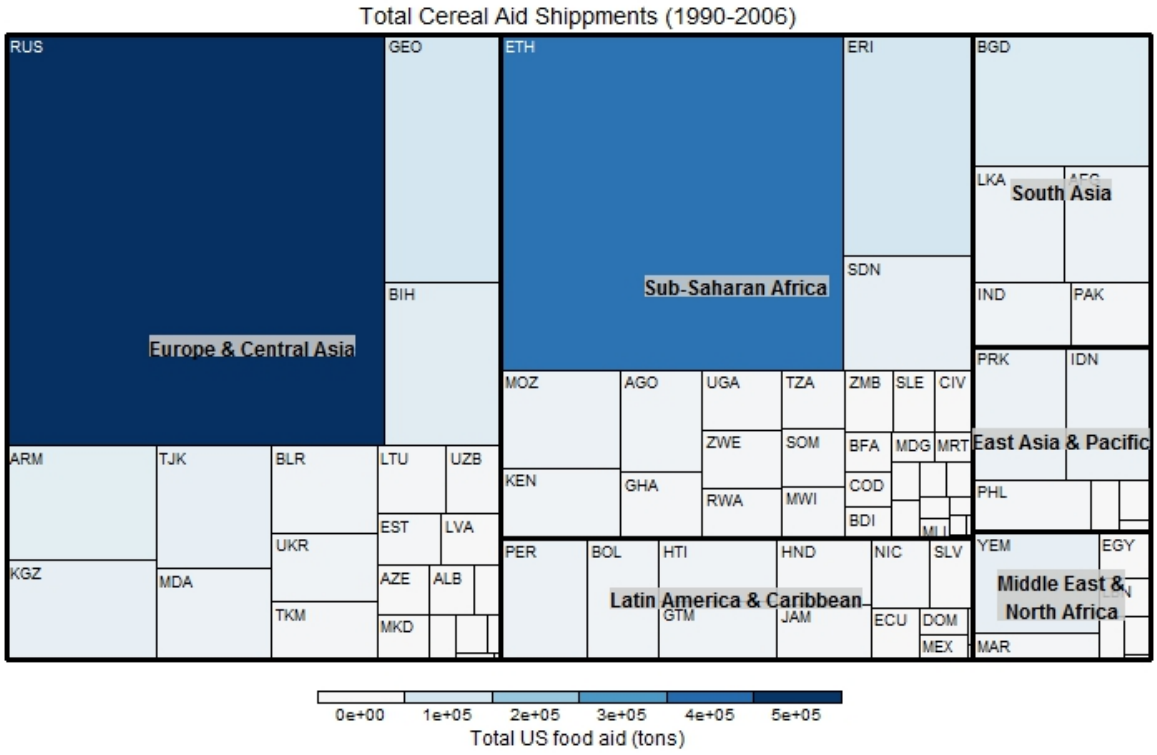
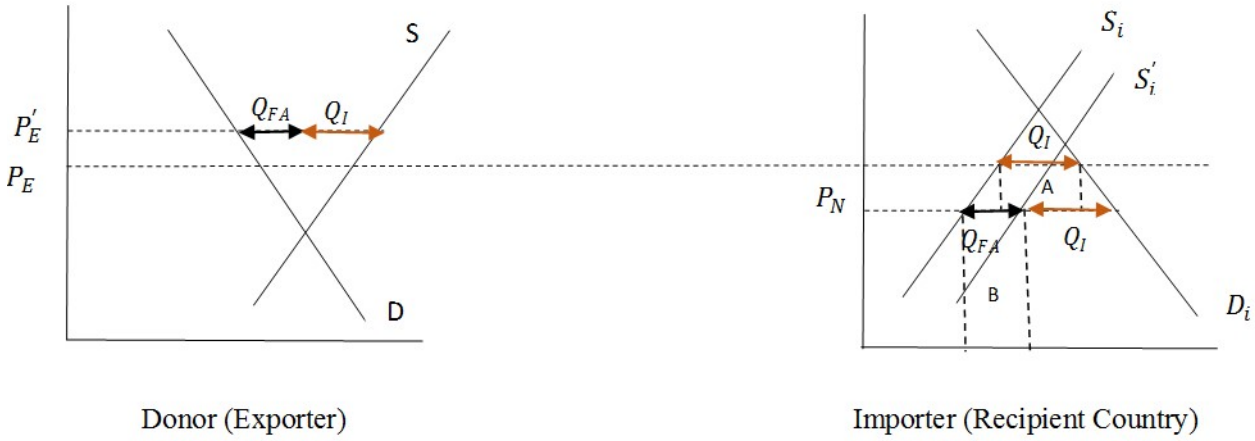


Figure 7: Effects of Program Food Aid Given a Successful Enforcement of UMRs

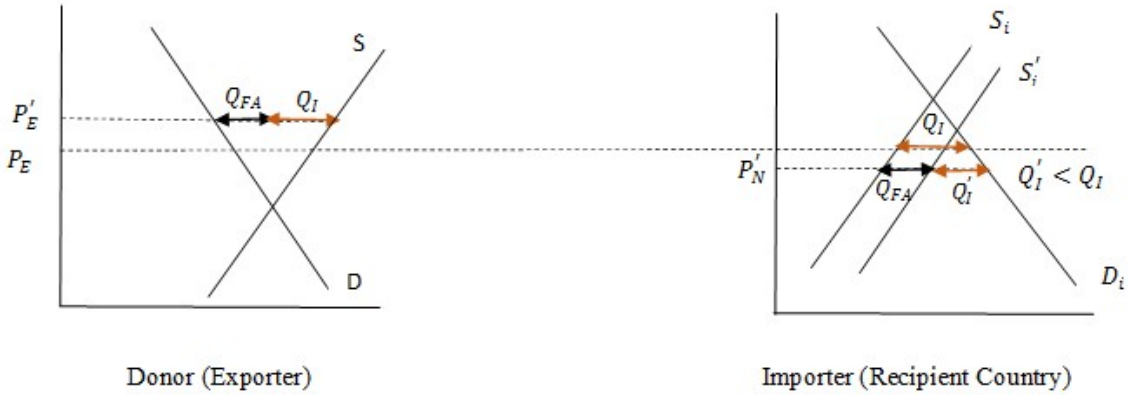


Donor (Exporter)

Importer (Recipient Country)

Figure 8: Effects of Program Food Aid Given a Unsuccessful Enforcement of UMRs

Figure 8-1: Effects of Program Food Aid Given an Unsuccessful Enforcement of UMRs and Partial Displacement of Imports



Donor (Exporter)

Importer (Recipient Country)

Figure 8-2: Effects of Program Food Aid Given an Unsuccessful Enforcement of UMRs and Full Displacement of Imports

Donor (Exporter)

Importer (Recipient Country)

Figure 9: Effects of Targeted Food Aid

Figure 9-1: Effects of Targeted Food Aid (Project Food Aid)

Donor (Exporter) Importer (Recipient Country)

Figure 9-2: Effects of Targeted Food Aid (Emergency Food Aid)

Donor (Exporter) Importer (Recipient Country)

Figure 10: Relationships between U.S. Wheat Stocks and U.S. Cereal Aid

Fig 10-1: U.S. Wheat Stocks Versus U.S. Wheat Aid in the Following Year

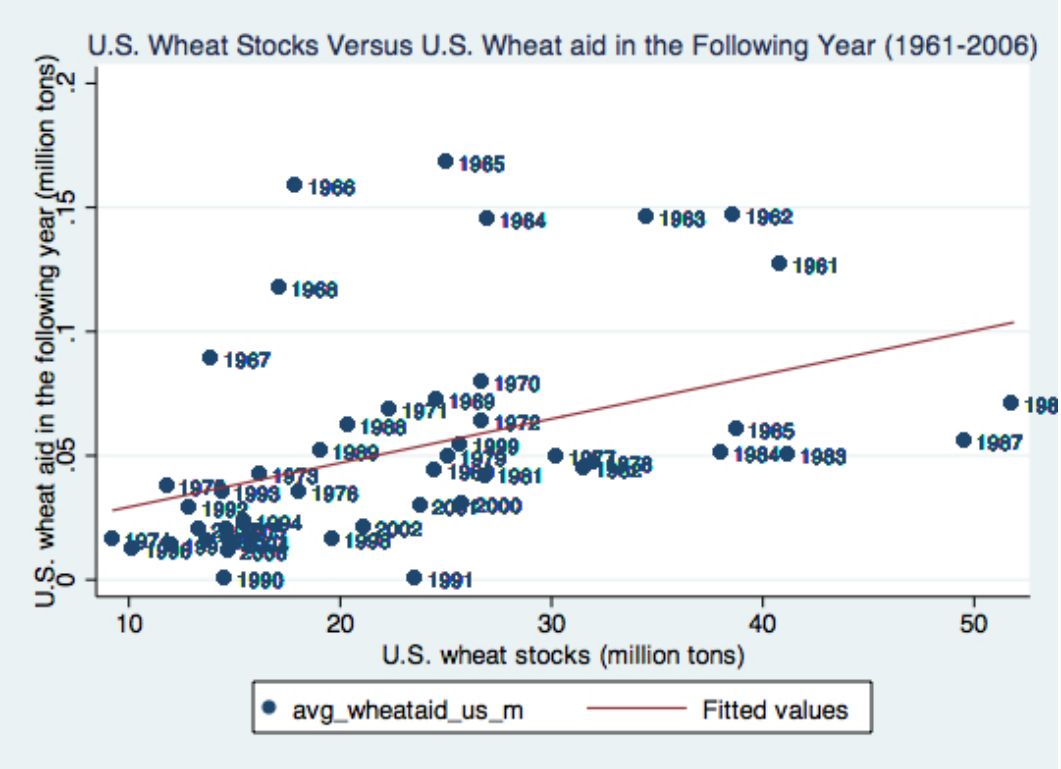


Fig 10-2: U.S. Wheat Aid Versus U.S. Cereal Aid

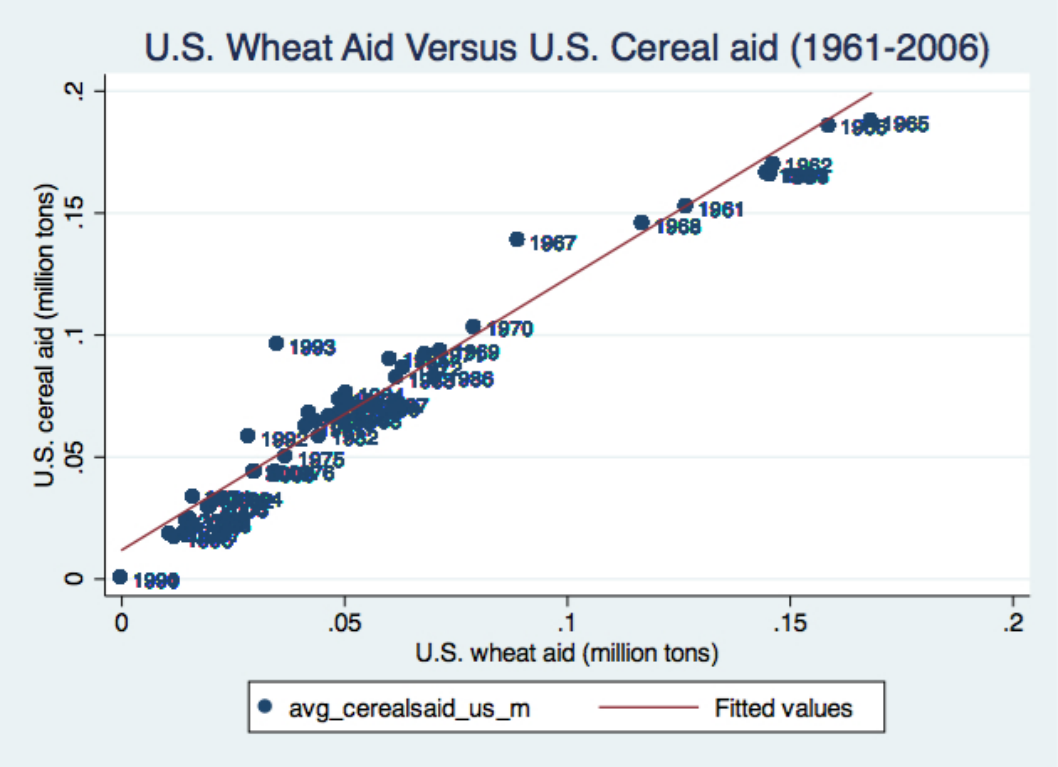


Figure 11: Relationships between U.S. Cereal Aid and U.S. Millitary Aid and Alignment

Fig 11-1: U.S. Cereal Aid Versus U.S. Military Aid

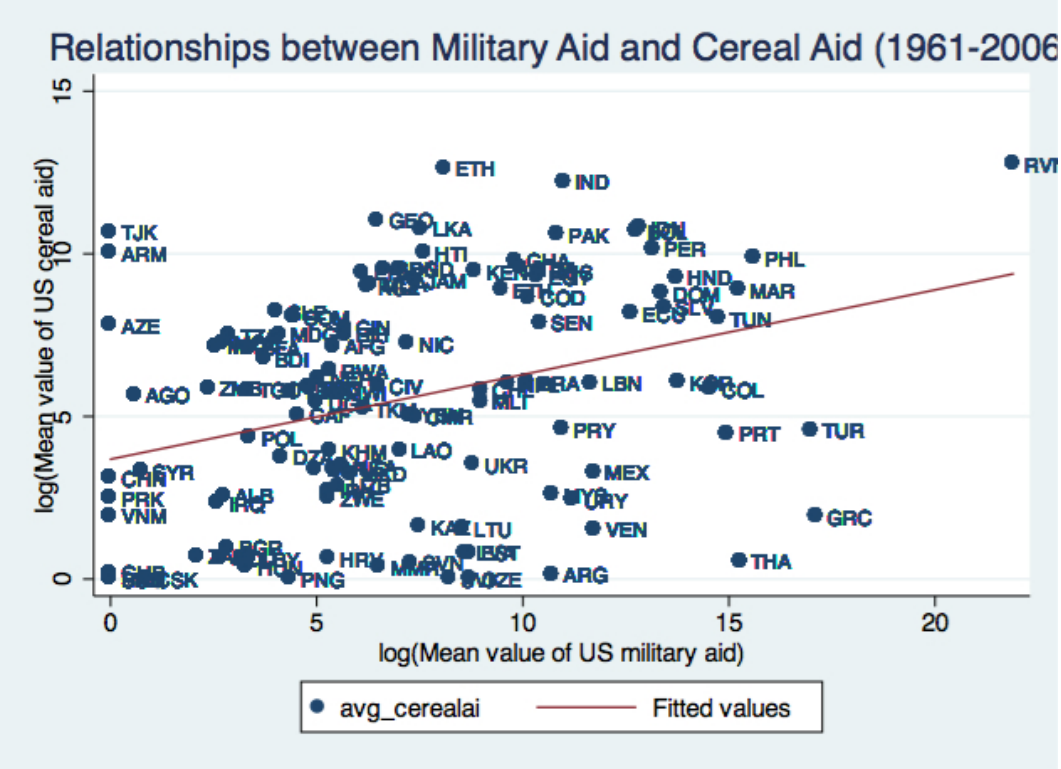


Fig 11-2: U.S. Cereal Aid Versus Alignment

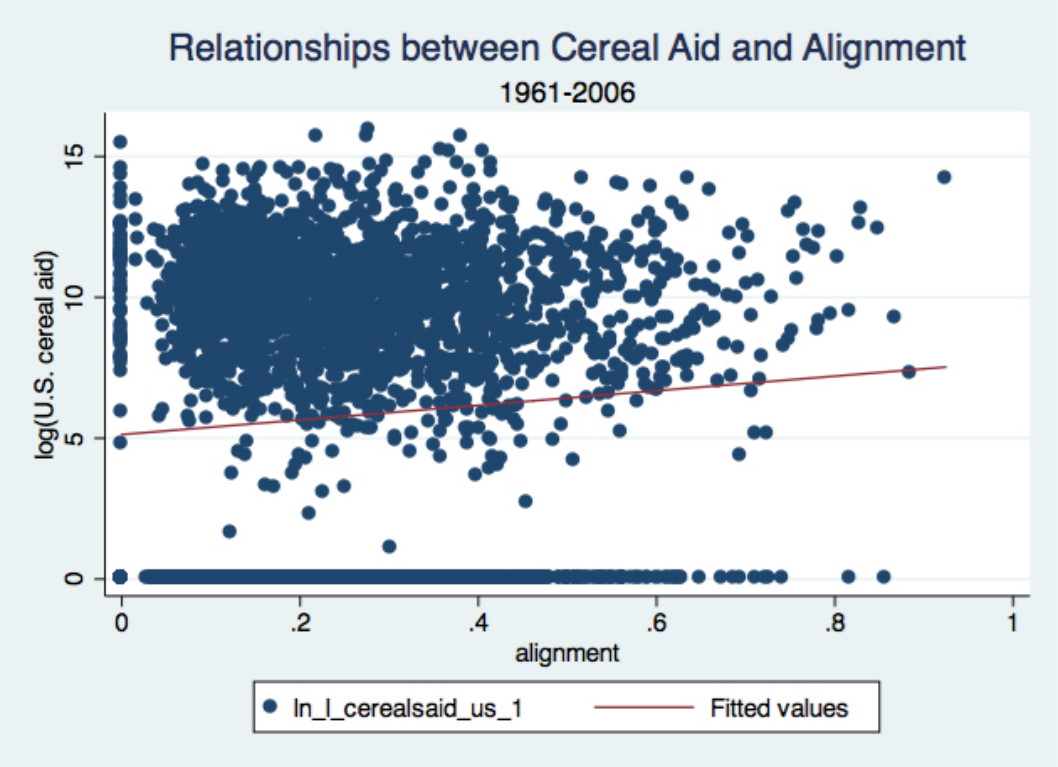


Figure 12: Quantities of Cereal Production and Cereal Aid in Selected Countries

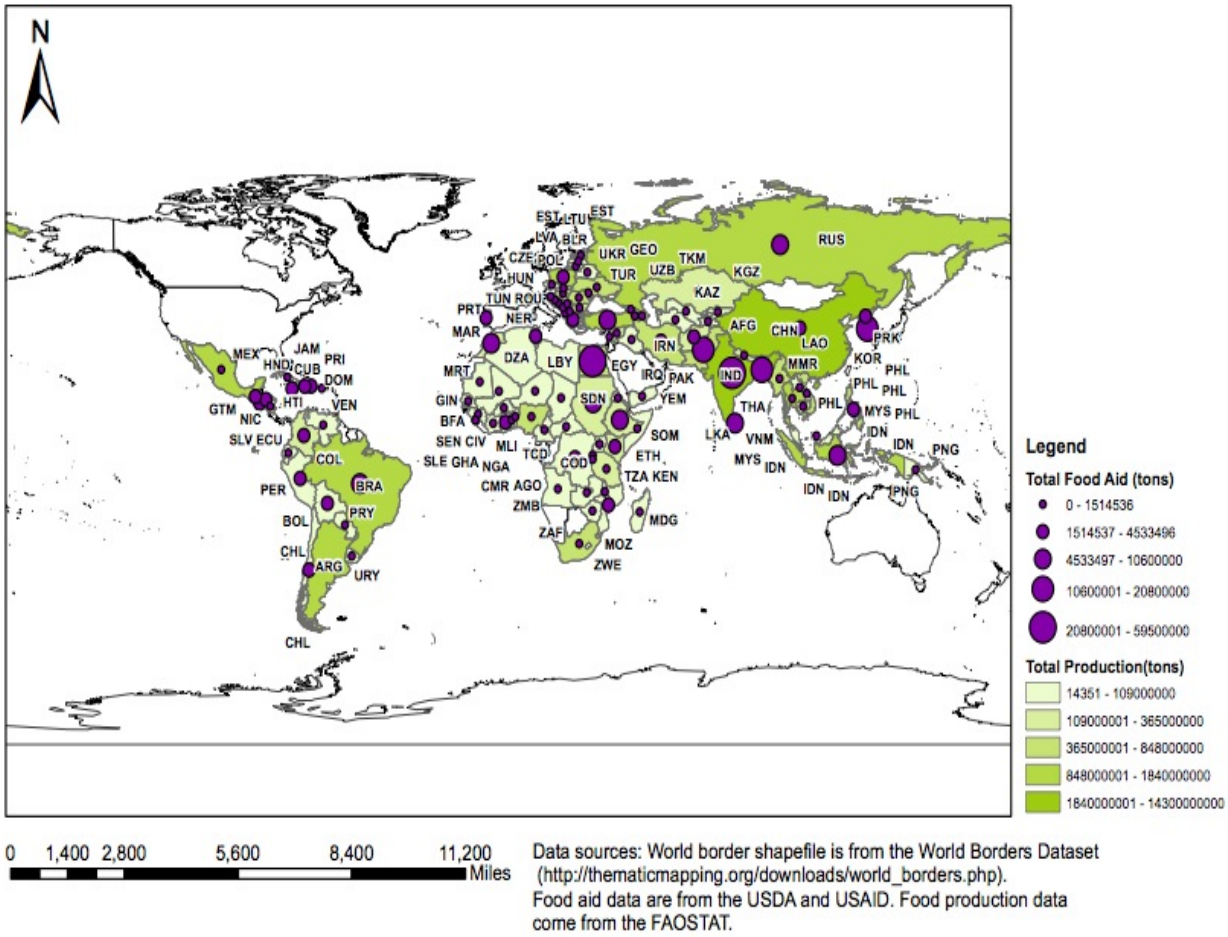


Table 1: U.S. International Food Aid Programs

Table 1: U.S. Food Assistance Programs

	Food for Peace Act (FFPA)				Other Programs				
	Title I	Title II	Title III	Title V	Food for Progress	Emergency Food Security Program	Section 416(b)	McGovern-Dole International Food for Education and ChildNutrition Program	Bill Emerson Humanitarian Trust
Year Begun	1954	1954	1954	1985	1985	2010	1949	2002	1980
Agency	USDA	USAID	USAID	USAID	USAID	USAID	USDA	USDA	USDA
Funding	D	D	D	D	D	D	M	D	M
Annual Outlays	Title I	Title II	Other Food Assistance					McGovern-Dole IFECN	Total
1960-1969	6215, 66%	3202, 34%	-					-	9417
1970-1979	3535, 63%	2082, 37%	-					-	5617
1980-1989	1809, 52%	1599, 46%	-					47, 2%	3456
1990-1999	826, 28%	1370, 46%	-					757, 26%	2953
2000-2009	141, 5%	2023. 76%	102, 4%					403, 15%	2668
2010-2013	11, 0%	1643, 67%	192, 8%					602, 25%	2448

Source: Data are from the Congressional research Service (2015).
Note: Annual outlays contain the quantity of aid measured in million dollars and percentage of a particular program out of the total dollar amount. All numbers are inflation-adjected prices using 2013 as the constant year.

Table 2: Timeline of U.S. Food Aid Shipments

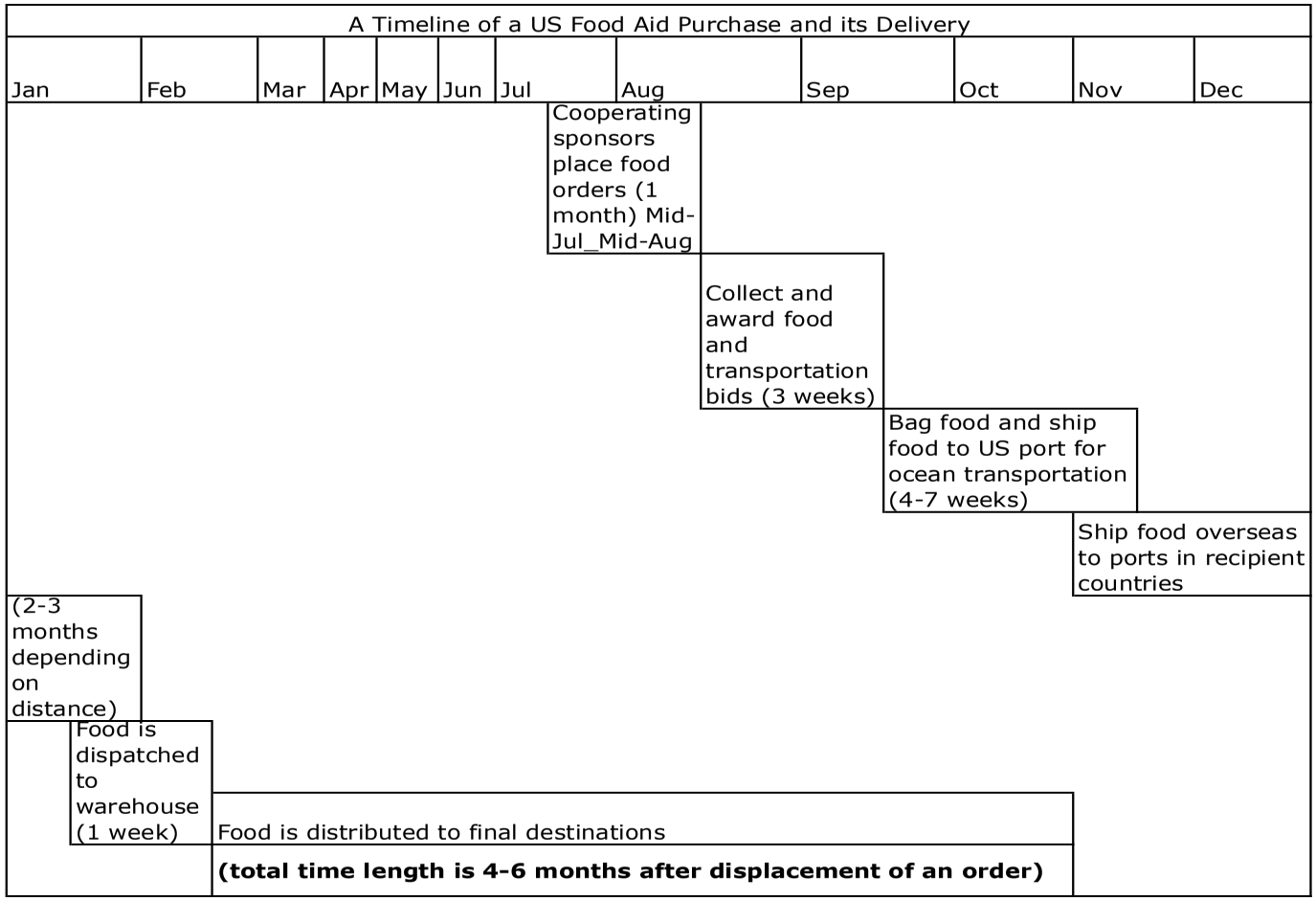


Table 3: A List of Countries

A List of Countries By Regions					
East Asia & Pacific	*Europe & Central Asia*	*Latin America & Caribbean*	*Middle East & North Africa*	*South Asia*	*Sub-Saharan Africa*
Cambodia	Albania	Argentina	Algeria	Afghanistan	Angola
China	Armenia (92-06)	Bolivia	Egypt	Bangladesh	Benin
Indonesia	Azerbaijan (92-06)	Brazil	Iran	India	Burkina Faso
Laos	Belarus (92-06)	Chile	Iraq	Nepal	Burundi
Malaysia	Bosnia Herzegovina (92-06)	Colombia	Lebanon	Pakistan	Cameroon
Myanmar	Bulgaria	Cuba	Libya	Sri Lanka	African Republic
North Korea	Croatia (92-06)	Dominican Republic	Morocco		Chad
Papua New Guinea	Czech Republic (93-06)	Ecuador	North Yemen (61-89)		Cote D'Ivoire
Philippines	Czechoslovakia (61-92)	El Salvador	Syria		DR Congo
South Korea	Estonia (92-06)	Guatemala	Tunisia		Eritrea (93-06)
South Vietnam (61-75)	Georgia (92-06)	Haiti	Yemen (90-06)		Ethiopia (93-06)
Thailand	Greece	Honduras			Ethiopia PDR (61-92)
Vietnam (76-06)	Hungary	Jamaica			Ghana
	Kazakhstan (92-06)	Mexico			Guinea
	Kyrgyzstan (92-06)	Nicaragua			Kenya
	Latvia (92-06)	Paraguay			Madagascar
	Lithuania (92-06)	Peru			Malawi
	Macedonia (92-06)	Puerto Rica			Mali
	Moldova (92-06)	Uruguay			Mauritania
	Montenegro (06)	Venezuela			Mozambique
	Poland				Niger
	Portugal				Nigeria
	Romania				Rwanda
	Russia (92-06)				Senegal
	Serbia (06)				Sierra Leone
	Serbia Montenegro (03-05)				Somalia
	Slovakia (93-06)				South Africa
	Slovenia (92-06)				Sudan
	Tajikistan (92-06)				Tanzania
	Turkey				Togo
	Turkmenistan (92-06)				Uganda
	Ukraine (92-06)				Zambia
	Ussr (61-91)				Zimbabwe
	Uzbekistan (92-06)				
	Yugoslavia (61-92)				

Table 4: Summary Statistics

	count	mean	sd	min	max
recipient countries	4429	58.47	33.86	1	118
year coded	4429	1984.52	13.45	1961	2006
US cereal aid	4429	70832.15	321225.85	0	8489998
US cereal aid per capita	4429	0.00	0.01	0	0
US cereal aid(kcal)	4429	2.34e+08	1.07e+09	0	2.82e+10
US cereal aid(cal)per capita	4429	12.60	33.02	0	442
Cereal Production	4429	11596800.27	39866320.84	428	458395648
Cereal Production per capita	4429	0.24	0.23	0	2
Cereal Production (cal)	4429	3.60e+10	1.29e+11	1523680	1.53e+12
Cereal Production (cal)per capita	4429	737.74	749.84	0	5728
Deviation of rain	4307	-0.07	175.09	-1143	1545
Population	4429	40078.79	132243.52	692	1313974
Disasters	4429	1.43	2.85	0	37
Conflict	4429	0.25	0.43	0	1
Openness score	4065	60.27	38.84	1	623
Real GDP per capita	4065	4511.86	4771.24	306	56312
Democracy score	4209	2.72	3.58	0	10
Arable land (%total)	4429	0.16	0.14	0	1
Military Aid per capita	4429	2.86	16.38	0	403
log(U.S. Military Aid)	4429	7.31	7.81	0	23
US economic aid per capita	4429	5.47	14.99	0	327
Cereal imports per capita	4429	0.05	0.06	0	1
Net cereal imports per capita	4263	0.05	0.06	0	1
Net cereal imports per capita(cal)	4240	148.64	213.54	0	1879
Align	4149	0.24	0.15	0	1
FAO wheat producer price	2181	1.40e+09	1.61e+10	0	2.59e+11

Table 5: Summary Statistics by Regions

Region	stats	Disasters	Conflict	Openness	GDP per capita	Democracy
East Asia & Pacific	mean	2.931	0.429	63.322	3687.528	2.548
	min	0.000	0.000	4.263	429.591	0.000
	max	37.000	1.000	215.684	22972.610	10.000
Europe & Central Asia	mean	0.996	0.090	68.896	8174.263	4.296
	min	0.000	0.000	2.260	1340.077	0.000
	max	25.000	1.000	293.946	26690.800	10.000
Latin America & Caribbean	mean	1.463	0.155	52.717	6477.003	4.464
	min	0.000	0.000	7.335	1452.979	0.000
	max	11.000	1.000	174.326	26940.020	10.000
Middle East & North Africa	mean	0.757	0.311	85.678	6904.548	0.353
	min	0.000	0.000	30.599	737.594	0.000
	max	9.000	1.000	353.707	56311.590	8.000
South Asia	mean	3.851	0.529	40.019	1762.324	3.988
	min	0.000	0.000	9.876	306.318	0.000
	max	31.000	1.000	152.001	5786.568	9.000
Sub-Saharan Africa	mean	0.828	0.258	56.862	1682.764	1.400
	min	0.000	0.000	1.086	312.406	0.000
	max	12.000	1.000	622.626	9978.645	9.000
Total	mean	1.433	0.251	60.269	4511.859	2.720
	min	0.000	0.000	1.086	306.318	0.000
	max	37.000	1.000	622.626	56311.590	10.000

Table 6: Structure of Cereal Aid Data

2000	"Grains and preparations"
2100	"Wheat and products"
2110	"Wheat and wheat flour"
2111	"Wheat"
2112	"Wheat flour"
2119	"Wheat and flour-Other"
2120	"Bulgar and rolled wheat"
2190	"Wheat Products-Other"
2200	"Rice"
2300	"Feed grains and products"
2310	"Feed grains"
2311	"Barley"
2312	"Corn"
2313	"Grain sorghum"
2319	"Feed grains-Other"
2320	"Cornmeal"
2330	"Rolled oats"
2390	"Feed Grain Products-Other"
2400	"Defatted flour"
2500	"Blended Good products"
2900	"Grains-Other"

Table 7: Determinants of Food Aid

	(1) OLS coeff	(2) Tobit coeff	(3) Tobit_M marginal	(4) Tobit_MC coeff	(5) Tobit_MC_M marginal
log(US cereal prod)t	0.29	0.36	0.18	0.37	0.18
	(0.575)	(0.792)	(0.381)	(0.791)	(0.381)
log(US cereal prod)t-1	0.91*	1.45*	0.70*	1.47*	0.71*
	(0.508)	(0.792)	(0.382)	(0.791)	(0.382)
Democracy score	0.022	0.0034	0.0016	0.030	0.015
	(0.0571)	(0.0470)	(0.0226)	(0.0486)	(0.0234)
Alignment	1.97**	3.46***	1.66***	3.60***	1.73***
	(0.909)	(0.885)	(0.429)	(0.893)	(0.435)
Conflict	-0.43	-0.54*	-0.26*	-0.52*	-0.25*
	(0.364)	(0.305)	(0.147)	(0.304)	(0.147)
Log(population)	3.19**	2.58***	1.24***	7.43***	3.58***
	(1.584)	(0.574)	(0.280)	(1.264)	(0.621)
Log(GDP per capita)	-2.59***	-4.58***	-2.20***	-4.37***	-2.11***
	(0.653)	(0.365)	(0.193)	(0.448)	(0.230)
log(Cereal Production)t	-0.77*	-0.85**	-0.41**	-1.12***	-0.54***
	(0.412)	(0.349)	(0.169)	(0.404)	(0.196)
log(Cereal Production)t-1	-0.41**	-0.76***	-0.36***	-0.69***	-0.33***
	(0.184)	(0.204)	(0.0987)	(0.203)	(0.0985)
Disasters	0.12**	0.16***	0.075***	0.16***	0.078***
	(0.0485)	(0.0561)	(0.0272)	(0.0570)	(0.0277)
Log(US military aid)	0.073***	0.13***	0.062***	0.12***	0.056***
	(0.0180)	(0.0159)	(0.00806)	(0.0161)	(0.00803)
Observations	3700	3700	3700	3700	3700

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and time trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 8: Determinants of Food Aid (Before and After 1990 and 1985)

	(1) Tobit	(2) Before-1990	(3) After-1990
log(US cereal prod)t	0.18	1.11**	-0.58
	(0.381)	(0.474)	(0.833)
log(US cereal prod)t-1	0.71*	1.98***	-0.39
	(0.382)	(0.473)	(0.847)
Democracy score	0.015	-0.040	0.026
	(0.0234)	(0.0348)	(0.0406)
Conflict	-0.25*	-0.075	0.0013
	(0.147)	(0.207)	(0.222)
Alignment	1.73***	1.05**	2.82**
	(0.435)	(0.532)	(1.123)
Log(population)	3.58***	2.16**	9.00***
	(0.621)	(1.096)	(1.310)
Log(GDP per capita)	-2.11***	-2.85***	-1.14**
	(0.230)	(0.385)	(0.474)
log(Cereal Production)t	-0.54***	0.077	-0.33
	(0.196)	(0.336)	(0.278)
log(Cereal Production)t-1	-0.33***	-1.51***	-0.13
	(0.0985)	(0.340)	(0.0868)
Disasters	0.078***	0.028	0.12**
	(0.0277)	(0.0512)	(0.0558)
Log(US military aid)	0.056***	0.13***	-0.0065
	(0.00803)	(0.0129)	(0.0146)
Observations	3700	2133	1567

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and time trends.Coefficients are marginal effects

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 9: Determinants of Food Aid by Regions

	(1) EA_P	(2) Eu_CA	(3) LA_C	(4) ME	(5) SA	(6) SSA
log(US cereal prod)t	-0.59	-2.10**	-0.57	0.77	-0.51	2.72***
	(0.976)	(0.995)	(0.790)	(1.192)	(1.960)	(0.761)
log(US cereal prod)t-1	-0.87	-0.27	0.73	-0.48	-1.73	2.82***
	(1.002)	(0.985)	(0.806)	(1.152)	(1.920)	(0.750)
Democracy score	0.065	0.025	-0.027	0.26	-0.33***	0.030
	(0.0643)	(0.0564)	(0.0465)	(0.178)	(0.122)	(0.0532)
Alignment	0.78	2.47**	0.58	0.18	7.06**	-0.69
	(1.178)	(1.040)	(0.755)	(1.568)	(3.002)	(0.982)
Log(population)	-1.54	1.36	8.91***	-6.20***	13.3**	-2.30
	(3.151)	(1.834)	(1.744)	(2.053)	(5.344)	(1.635)
Log(GDP per capita)	-2.07***	-1.76**	-3.87***	-1.20*	-0.94	2.11***
	(0.677)	(0.787)	(0.624)	(0.637)	(2.113)	(0.488)
log(Cereal Production)t	1.43	-1.11**	-0.43	-0.056	-1.50	-0.065
	(0.903)	(0.498)	(0.682)	(0.419)	(2.698)	(0.443)
log(Cereal Production)t-1	1.15	-0.23***	-1.81***	0.16	-4.41*	-1.92***
	(0.911)	(0.0855)	(0.696)	(0.411)	(2.645)	(0.450)
Disasters	0.091**	0.075	0.021	-0.11	-0.067	0.13
	(0.0395)	(0.0779)	(0.0751)	(0.156)	(0.0928)	(0.0832)
Log(US military aid)	0.022	0.045**	0.037**	0.12***	0.10**	0.0055
	(0.0266)	(0.0219)	(0.0177)	(0.0242)	(0.0427)	(0.0156)
Observations	334	606	845	389	240	1286

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and time trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 10: Determinants of Food Aid (Other Types)

	(1) Animal log(US animal prod aid)	(2) Oilseeds log(US oilseed aid)
log(US prod)t	9.55*	1.16
	(5.328)	(0.942)
log(US prod)t-1	9.83*	4.06***
	(5.193)	(0.928)
Democracy score	-0.034	0.14***
	(0.0581)	(0.0462)
Alignment	-3.82***	3.36***
	(0.999)	(0.843)
Log(population)	-3.50**	7.03***
	(1.499)	(1.157)
Log(GDP per capita)	-2.79***	-3.96***
	(0.543)	(0.423)
log(production)t	-3.41*	0.55*
	(1.792)	(0.928)
log(production)t-1	3.88**	-0.90***
	(1.790)	(0.336)
Disasters	0.26***	0.27***
	(0.0702)	(0.0536)
Conflict	-0.31	-0.32
	(0.353)	(0.284)
Log(US military aid)	0.12***	0.063***
	(0.0191)	(0.0150)
Observations	3696	3695

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and time trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 11: Effects of Food Aid on Production with wheat stocks × log(military aid) × alignment as the Instrument

	(1) OLS	(2) FStage	(3) RForm	(4) 2SLS	(5) Wheat	(6) Rice	(7) Feed Grains	(8) Calories
Log(cereal aid)t-1	-0.0100**			-0.062***				
	(0.00453)			(0.0169)				
Log(population)t-1	0.97***	1.54	0.98***	1.08***	1.19***	0.020	1.15***	1.09***
	(0.227)	(1.288)	(0.225)	(0.199)	(0.243)	(1.806)	(0.265)	(0.194)
Deviation precip	0.00017***	-0.00043	0.00016***	0.00013***	0.00018***	0.00042	0.00011**	0.00014***
	(0.0000465)	(0.000291)	(0.0000460)	(0.0000444)	(0.0000553)	(0.000504)	(0.0000451)	(0.0000450)
Disasters t-2	0.0048	0.045	0.0019	0.0047	0.0019	0.026	0.0036	0.0043
	(0.00423)	(0.0465)	(0.00478)	(0.00543)	(0.00573)	(0.0629)	(0.00620)	(0.00554)
Conflict t-2	-0.051*	-0.026	-0.071**	-0.073**	-0.078*	-0.31	-0.050	-0.073**
	(0.0294)	(0.300)	(0.0300)	(0.0343)	(0.0403)	(0.537)	(0.0330)	(0.0340)
Democracy score t-2	0.0089	0.057	0.0056	0.0091	0.014	-0.055	0.0081	0.0077
	(0.00655)	(0.0595)	(0.00619)	(0.00697)	(0.00878)	(0.114)	(0.00772)	(0.00695)
Log(US_economic_aid)t-2	-0.0013	0.21***	0.0010	0.014***	0.018***	-0.058	0.011**	0.012**
	(0.00231)	(0.0233)	(0.00217)	(0.00470)	(0.00653)	(0.113)	(0.00468)	(0.00487)
Openness score t-2	-0.00035	0.0020	-0.00042	-0.00030	-0.00043	0.0026	0.00033	-0.00031
	(0.000522)	(0.00376)	(0.000518)	(0.000471)	(0.000532)	(0.00649)	(0.000599)	(0.000474)
Log(GDP per capita)t-2	0.16**	-3.12***	0.17***	-0.019	0.0047	0.86	0.023	0.0041
	(0.0628)	(0.623)	(0.0650)	(0.0822)	(0.0853)	(1.446)	(0.0840)	(0.0850)
Arable land t-2	0.77	18.3***	0.59	1.72***	1.30*	-6.47	1.47**	1.84***
	(0.652)	(5.775)	(0.625)	(0.637)	(0.665)	(14.82)	(0.713)	(0.653)
US_W_product*US_Mil_aid*align		0.0099***	-0.00061***					
		(0.00207)	(0.000151)					
log(wheat aid)t-1					-0.080***			
					(0.0245)			
log(rice aid)t-1						0.76		
						(1.512)		
log(feed grain aid)t-1							-0.077***	
							(0.0238)	
Log(cereal aid)_cal_t-1								-0.032***
								(0.0103)
Observations	3629	3531	3531	3531	3531	3531	3531	3531

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006.

All regressions include country fixed effects and year fixed effects. Columns 4-8 contain the 2SLS estimators.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 12: Effects of Food Aid on Production with wheat stocks × log(military aid) as the Instrument

	(1) FStage	(2) RForm	(3) 2SLS	(4) Calories	(5) 2SLS RS
Instrument	0.0026***	-0.00015**			
	(0.000717)	(0.0000589)			
Log(population)t-1	1.39	0.98***	1.05***	1.08***	1.08***
	(1.323)	(0.227)	(0.199)	(0.192)	(0.200)
Deviation precip	-0.00051*	0.00017***	0.00014***	0.00014***	0.00013***
	(0.000293)	(0.0000475)	(0.0000456)	(0.0000470)	(0.0000440)
Disasters t-2	0.013	0.0038	0.0046	0.0042	0.0047
	(0.0498)	(0.00413)	(0.00506)	(0.00523)	(0.00549)
Conflict t-2	-0.029	-0.052*	-0.053	-0.054	-0.073**
	(0.281)	(0.0296)	(0.0329)	(0.0334)	(0.0348)
Openness score t-2	0.00076	-0.00041	-0.00036	-0.00038	-0.00030
	(0.00381)	(0.000528)	(0.000477)	(0.000479)	(0.000472)
Log(GDP per capita)t-2	-3.25***	0.19***	0.0046	0.0091	-0.023
	(0.613)	(0.0622)	(0.0988)	(0.110)	(0.102)
Arable land t-2	18.7***	0.67	1.71**	1.93**	1.74**
	(5.794)	(0.651)	(0.761)	(0.853)	(0.764)
Log(US economic aid)t-2	0.21***	-0.00078	0.011	0.010	0.014**
	(0.0237)	(0.00243)	(0.00683)	(0.00798)	(0.00696)
Democracy score t-2	0.030	0.0091	0.011	0.0094	0.0092
	(0.0557)	(0.00654)	(0.00680)	(0.00681)	(0.00709)
Log(cereal aid)t-1			-0.056**		-0.060**
			(0.0258)		(0.0269)
Log(cereal aid)_cal_t-1				-0.032*	
				(0.0178)	
Observations	3629	3629	3629	3629	3531

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and year fixed effects. Columns 3-5 contain the 2SLS estimators.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 13: Effects of Food Aid on Production with a One-Year Lagged Dependent Variable

	(1) FStage	(2) RForm	(3) 2SLS	(4) A-B	(5) A-B_Cal
US_W_product*US_Mil_aid*align	0.0092***	-0.00021***			
	(0.00204)	(0.0000783)			
L.log(Cereal Production)	-1.10***	0.58***	0.55***	0.14**	
	(0.419)	(0.0556)	(0.0577)	(0.0649)	
Log(population)t-1	2.61**	0.42***	0.48***	0.46**	0.49**
	(1.235)	(0.105)	(0.0994)	(0.211)	(0.213)
Deviation precip	-0.00038	0.00014***	0.00013***	0.00016***	0.00016***
	(0.000279)	(0.0000285)	(0.0000278)	(0.0000247)	(0.0000248)
Disasters t-2	0.049	-0.00029	0.00084	0.00093	0.00086
	(0.0461)	(0.00223)	(0.00259)	(0.00299)	(0.00302)
Conflict t-2	-0.085	-0.040***	-0.042**	-0.0032	-0.0015
	(0.304)	(0.0148)	(0.0165)	(0.0172)	(0.0174)
Openness score t-2	0.0014	-0.00012	-0.000092	0.00014	0.00012
	(0.00356)	(0.000248)	(0.000247)	(0.000366)	(0.000370)
Log(GDP per capita)t-2	-2.91***	0.064**	-0.0039	0.049	0.055
	(0.613)	(0.0306)	(0.0398)	(0.0654)	(0.0636)
Arable land t-2	19.0***	0.21	0.66*	-0.055	-0.086
	(5.547)	(0.280)	(0.339)	(0.559)	(0.566)
Log(US_economic_aid)t-2	0.21***	0.00060	0.0054**	-0.000083	-0.00041
	(0.0232)	(0.00107)	(0.00244)	(0.00159)	(0.00160)
Democracy score t-2	0.063	0.0024	0.0039	-0.0079**	-0.0078**
	(0.0590)	(0.00271)	(0.00313)	(0.00383)	(0.00387)
Log(cereal aid)t-1			-0.023**	-0.015*	
			(0.00913)	(0.00805)	
L.log(Cereal Production)_cal					0.16**
					(0.0631)
Log(cereal aid)_cal_t-1					-0.0069*
					(0.00404)
Observations	3531	3531	3531	3406	3406

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006.

All regressions include country fixed effects and year fixed effects. Column 3 reports 2SLS estimators, and 4-8 contain the Arellano-Bond esti

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 14: Validity of the Instrument

	(1) LWS_OneY	(2) LWS_TwoY	(3) LWS_ThreeY	(4) LFGS_TwoY	(5) Inst_t	(6) Inst_t+1	(7) FA_t+1	(8) FA_t+2
US_W_product_t-1								
US_Mil_aid_t-2*align_t-2	0.0092***							
	(0.00219)							
L.log(Cereal Production)	-1.11***	-1.10***	-1.13***	-1.18***	-1.76**	-1.87**	0.15**	0.16**
	(0.419)	(0.419)	(0.414)	(0.426)	(0.765)	(0.802)	(0.0659)	(0.0702)
Log(population)t-1	2.64**	2.61**	2.73**	2.67**	0.54	-0.23	0.32	0.13
	(1.236)	(1.235)	(1.176)	(1.270)	(3.443)	(3.508)	(0.211)	(0.228)
Deviation precip	-0.00036	-0.00038	-0.00032	-0.00040	-0.00015	-0.00013	0.00016***	0.00016***
	(0.000279)	(0.000279)	(0.000277)	(0.000283)	(0.000412)	(0.000416)	(0.0000247)	(0.0000257)
Disasters t-2	0.048	0.049	0.052	0.031	0.048	0.075	0.00070	0.0031
	(0.0462)	(0.0461)	(0.0447)	(0.0466)	(0.0859)	(0.0897)	(0.00309)	(0.00321)
Conflict t-2	-0.093	-0.085	-0.094	-0.037	-0.55*	-0.58*	0.0057	-0.0041
	(0.306)	(0.304)	(0.306)	(0.318)	(0.312)	(0.317)	(0.0171)	(0.0176)
Openness score t-2	0.0012	0.0014	0.0020	0.00089	-0.0057*	-0.0060*	-0.000060	0.000022
	(0.00360)	(0.00356)	(0.00371)	(0.00359)	(0.00332)	(0.00335)	(0.000370)	(0.000376)
Log(GDP per capita)t-2	-2.92***	-2.91***	-2.82***	-2.89***	-5.87***	-6.22***	0.097	0.12*
	(0.614)	(0.613)	(0.585)	(0.627)	(1.012)	(1.027)	(0.0608)	(0.0646)
Arable land t-2	18.9***	19.0***	18.4***	18.8***	43.9***	44.7***	-0.090	-0.21
	(5.554)	(5.547)	(5.344)	(5.551)	(8.481)	(8.849)	(0.565)	(0.591)
Log(US_economic_aid)t-2	0.21***	0.21***	0.21***	0.22***	0.30***	0.30***	-0.0013	-0.00091
	(0.0232)	(0.0232)	(0.0228)	(0.0238)	(0.0316)	(0.0329)	(0.00152)	(0.00157)
Democracy score t-2	0.061	0.063	0.062	0.053	0.061	0.076	-0.0080**	-0.0073*
	(0.0592)	(0.0590)	(0.0570)	(0.0610)	(0.0996)	(0.102)	(0.00381)	(0.00388)
US_W_product_t-2								
US_Mil_aid_t-2*align_t-2		0.0092***						
		(0.00204)						
US_W_product_t-3								
US_Mil_aid_t-2*align_t-2			0.0086***					
			(0.00196)					
US_FGrains_product_t-2								
US_Mil_aid_t-2*align_t-2				0.018***				
				(0.00516)				
US_W_product_t								
US_Mil_aid_t*align_t					0.0055			
					(0.00500)			
US_W_product_t+1								
US_Mil_aid_t+1*align_t+1						0.0030		
						(0.00494)		
Log(cereal aid)t+1							-0.013	
							(0.00802)	
Log(cereal aid)t+2								-0.012
								(0.00963)
Observations	3531	3531	3470	3454	3333	3232	3308	3208

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006.

All regressions include country fixed effects and year fixed effects. Columns 1-6 are first-stage results. Columns 7-8 contain the Arellano-Bond estimators.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 15: Heterogeneous Effects

	(1)	(2)	(3)	(4)	(5)
	90	85	Region	Income	Propensity of receiving aid
log(aid)t-1_year90D	-0.019**				
	(0.00792)				
L.ln_CerealsProduct_1	0.12*	0.11*	0.14**	0.13*	0.15**
	(0.0633)	(0.0632)	(0.0672)	(0.0677)	(0.0655)
Log(population)t-1	0.48**	0.47**	0.47**	0.48**	0.44**
	(0.208)	(0.207)	(0.222)	(0.211)	(0.211)
Deviation precip	0.00016***	0.00016***	0.00017***	0.00016***	0.00016***
	(0.0000243)	(0.0000242)	(0.0000255)	(0.0000251)	(0.0000247)
Disasters t-2	0.0012	0.0012	0.000052	0.00054	0.0014
	(0.00294)	(0.00293)	(0.00314)	(0.00302)	(0.00300)
Conflict t-2	-0.0038	-0.0019	-0.0086	-0.0014	-0.0022
	(0.0169)	(0.0167)	(0.0191)	(0.0174)	(0.0172)
Openness score t-2	0.00012	0.000090	0.00014	0.00020	0.00015
	(0.000359)	(0.000358)	(0.000389)	(0.000372)	(0.000366)
Log(GDP per capita)t-2	0.047	0.056	0.049	0.057	0.075
	(0.0632)	(0.0618)	(0.0716)	(0.0662)	(0.0620)
Democracy score t-2	-0.0070*	-0.0068*	-0.0077*	-0.0080**	-0.0076**
	(0.00377)	(0.00377)	(0.00405)	(0.00383)	(0.00382)
Arable land t-2	-0.11	0.014	-0.18	-0.11	-0.11
	(0.550)	(0.548)	(0.598)	(0.562)	(0.560)
Log(US_economic_aid)t-2	0.00025	-0.00021	-0.00054	-0.00045	-0.00037
	(0.00157)	(0.00152)	(0.00174)	(0.00167)	(0.00156)
log(aid)t-1_year85D		-0.019**			
		(0.00791)			
log(cereal aid)t-1_EAP			-0.0029		
			(0.0276)		
log(cereal aid)t-1_ECA			0.0071		
			(0.0272)		
log(cereal aid)t-1_LAC			-0.0074		
			(0.0218)		
log(cereal aid)t-1_MENA			-0.014		
			(0.0234)		
log(cereal aid)t-1_SA			-0.039		
			(0.0261)		
log(cereal aid)t-1_SSA			-0.025*		
			(0.0129)		
log(cereal aid)_low				-0.021*	
				(0.0126)	
log(cereal aid)_lowMid				-0.012	
				(0.0125)	
log(cereal aid)_UpperMid				0.0036	
				(0.0246)	
log(cereal aid)t-1_regularRD					-0.017*
					(0.0101)
Observations	3406	3406	3406	3406	3406

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006.

All regressions include country fixed effects and year fixed effects.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 16: Robustness Tests

	(1) Non-US CerealA	(2) Animals	(3) Fruits	(4) Vegetable	(5) Oilseeds	(6) Tobacco	(7) Cotton
Log(cereal aid)t-1	0.40**	-0.0028	-0.0026	-0.00071	-0.018	0.0077	-0.0090
	(0.16)	(0.0024)	(0.0072)	(0.0043)	(0.011)	(0.014)	(0.015)
Log(population)t-1	1.52	0.010	0.18	0.070	-0.26	0.51	0.64
	(1.35)	(0.094)	(0.15)	(0.17)	(0.25)	(0.41)	(0.40)
Deviation precip	-0.00022	0.0000080	0.000012	0.000044***	0.000049	-0.000023	-0.000017
	(0.00031)	(0.0000073)	(0.000019)	(0.000014)	(0.000033)	(0.000041)	(0.000044)
Disasters t-2	0.060	0.0013	0.0027	0.000098	-0.00019	-0.0072	-0.0035
	(0.077)	(0.00090)	(0.0023)	(0.0016)	(0.0041)	(0.0051)	(0.0055)
Conflict t-2	0.40*	-0.0089*	0.0010	-0.021**	-0.0076	0.0069	-0.013
	(0.23)	(0.0052)	(0.013)	(0.0095)	(0.024)	(0.029)	(0.032)
Openness score t-2	-0.012***	-0.000089	-0.00024	-0.000086	-0.00063	0.00012	-0.0028***
	(0.0039)	(0.00011)	(0.00028)	(0.00020)	(0.00050)	(0.00063)	(0.00068)
Log(GDP per capita)t-2	-0.31	-0.097***	0.042	-0.043	-0.079	0.039	-0.24**
	(0.79)	(0.019)	(0.044)	(0.033)	(0.080)	(0.098)	(0.11)
Democracy score t-2	0.071	-0.0017	-0.00066	-0.0021	-0.0062	-0.019***	-0.0077
	(0.047)	(0.0011)	(0.0029)	(0.0021)	(0.0053)	(0.0066)	(0.0073)
Arable land t-2	0.62	-0.0057	-1.15**	0.27	1.22	0.95	-0.63
	(6.16)	(0.17)	(0.45)	(0.30)	(0.77)	(0.97)	(1.03)
Log(US_economic_aid)t-2	-0.044	0.00016	-0.0011	-0.00035	-0.00086	0.00028	0.0028
	(0.041)	(0.00048)	(0.0012)	(0.00084)	(0.0022)	(0.0027)	(0.0029)
L.log(Animal Prod)		0.76***					
		(0.087)					
L.log(Fruits Prod)			0.81***				
			(0.13)				
L.log(Vegetables Prod)				0.51***			
				(0.14)			
L.log(Oilseeds Prod)					0.55***		
					(0.13)		
L.log(Tobacco Prod)						0.48***	
						(0.18)	
L.log(Cotton Prod)							0.49***
							(0.14)
Observations	3531	3406	3406	3406	3406	3406	3406

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006.

All regressions include country fixed effects and year fixed effects.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 17: Robustness Tests without Outliers and Other Tests

	(1) NoRussia	(2) NoSouthVietnam	(3) FStage	(4) 2SLS	(5) AB
Log(cereal aid)t-1	-0.014*	-0.015*		-0.074**	-0.014*
	(0.0078)	(0.0080)		(0.034)	(0.0081)
L.ln_CerealsProduct_1	0.13*	0.14**			0.14**
	(0.065)	(0.065)			(0.065)
Log(population)t-1	0.47**	0.46**	2.19	1.10***	0.45**
	(0.21)	(0.21)	(1.35)	(0.19)	(0.21)
Deviation precip	0.00016***	0.00016***	-0.00043	0.00013***	0.00016***
	(0.000024)	(0.000025)	(0.00029)	(0.000049)	(0.000025)
Disasters t-2	0.00014	0.00093	0.024	0.0049	0.00093
	(0.0030)	(0.0030)	(0.047)	(0.0057)	(0.0030)
Conflict t-2	-0.0013	-0.0032	-0.083	-0.074**	-0.0027
	(0.017)	(0.017)	(0.31)	(0.037)	(0.017)
Openness score t-2	0.00014	0.00014	0.00045	-0.00030	0.00013
	(0.00036)	(0.00037)	(0.0038)	(0.00048)	(0.00037)
Log(GDP per capita)t-2	0.047	0.049	-3.17***	-0.059	0.051
	(0.065)	(0.065)	(0.64)	(0.13)	(0.066)
Democracy score t-2	-0.0076**	-0.0079**	0.049	0.0097	-0.0079**
	(0.0038)	(0.0038)	(0.061)	(0.0071)	(0.0038)
Arable land t-2	-0.064	-0.055	19.4***	1.95**	-0.084
	(0.55)	(0.56)	(6.04)	(0.85)	(0.56)
Log(US_economic_aid)t-2	-0.000079	-0.000083	0.23***	0.017*	-0.00014
	(0.0016)	(0.0016)	(0.023)	(0.0090)	(0.0016)
Observations	3394	3406	3531	3531	3406

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and year fixed effects.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 18: Effects of Food aid on Domestic Wheat Price

	(1) Prices	(2) LowIncome_Before1990
Log(cereal aid)t-1	-0.14	-0.017*
	(0.222)	(0.0097)
Log(population)t-1	4.93*	0.66
	(2.520)	(3.073)
Deviation precip	-0.00025	0.00031
	(0.000571)	(0.000904)
Disasters t-2	-0.048	-0.088
	(0.113)	(0.115)
Conflict t-2	-0.84	-0.98*
	(0.641)	(0.595)
Openness score t-2	-0.0047	-0.0065
	(0.0155)	(0.0131)
Log(GDP per capita)t-2	3.63	-1.34
	(4.521)	(1.700)
Democracy score t-2	-0.13	0.037
	(0.164)	(0.0375)
Arable land t-2	-9.78	13.6
	(21.71)	(20.94)
Log(US_economic_aid)t-2	-0.17	0.047
	(0.245)	(0.101)
Observations	1903	347

Standard errors in parentheses

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961-2006. All regressions include country fixed effects and year fixed effects.

* $p < .10$, ** $p < .05$, *** $p < .01$